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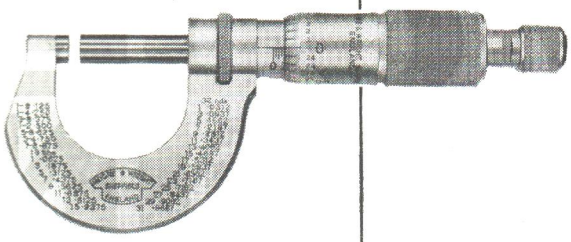

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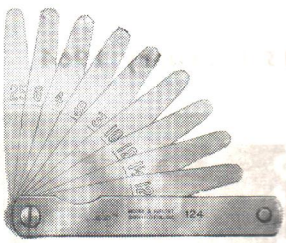

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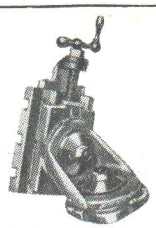

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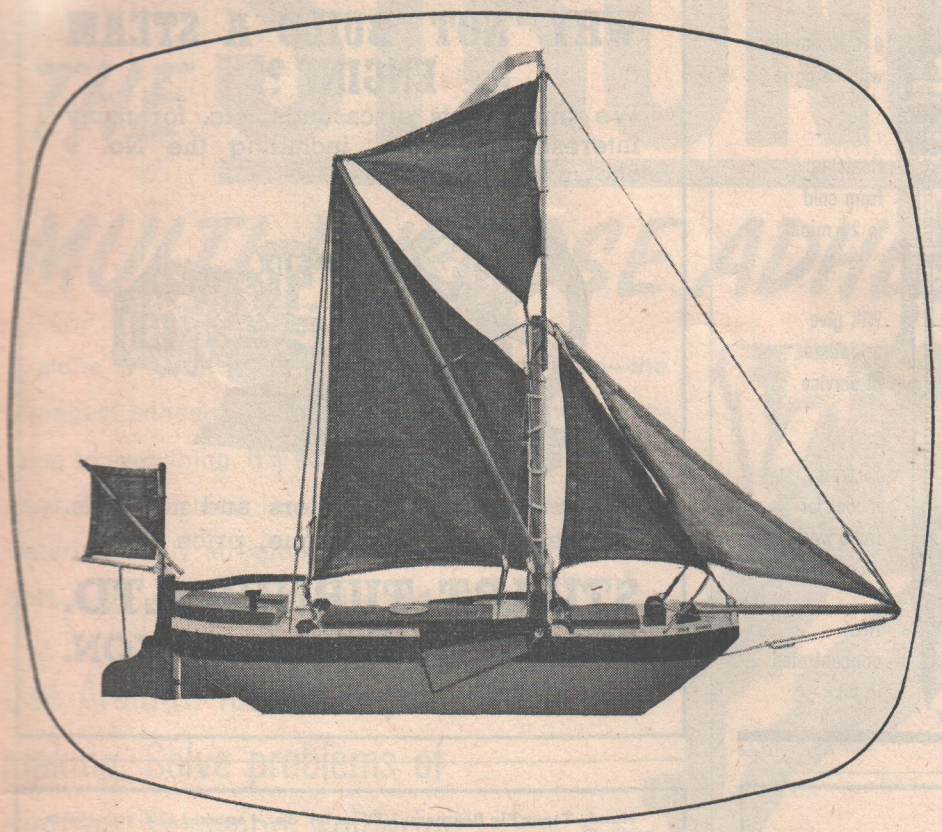

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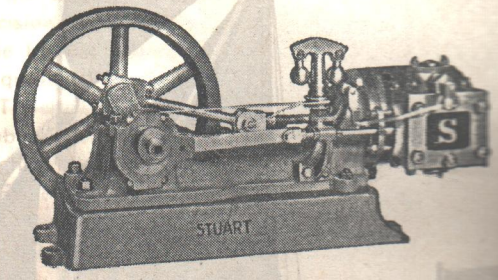

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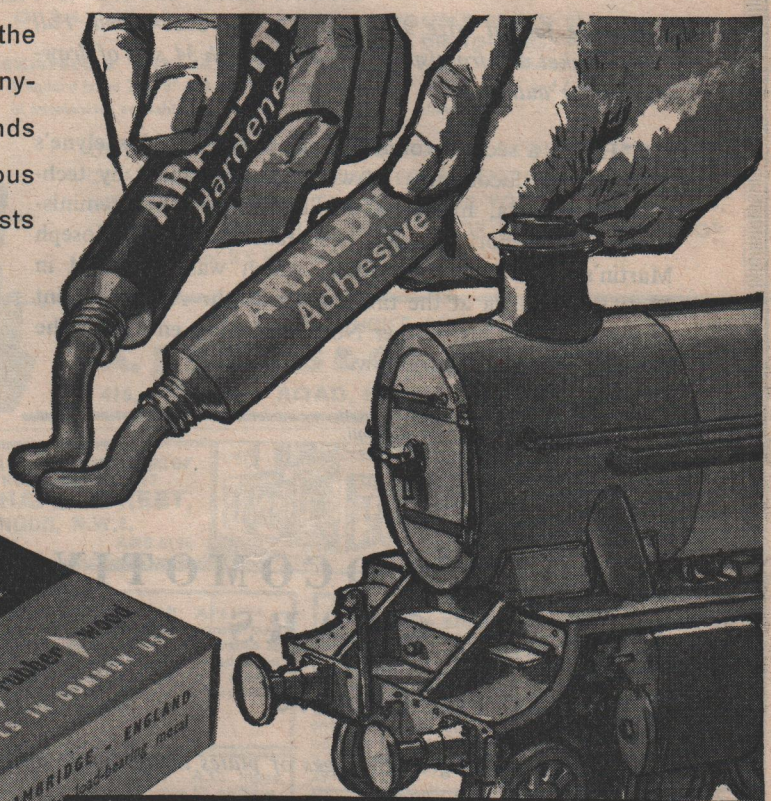

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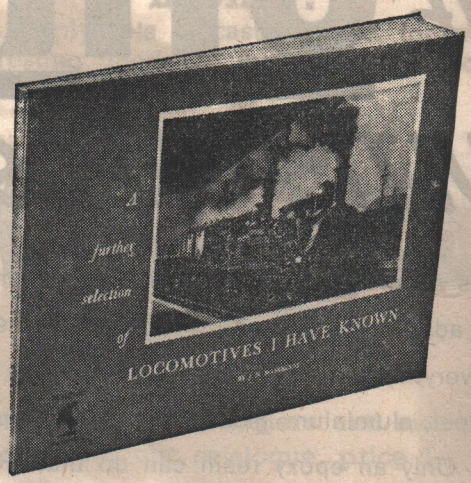

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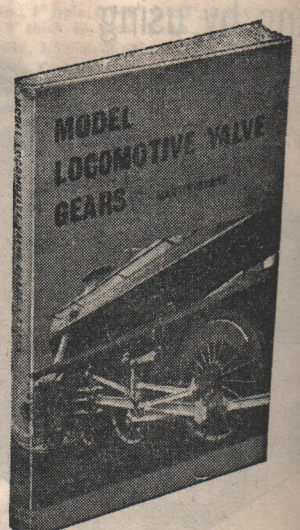

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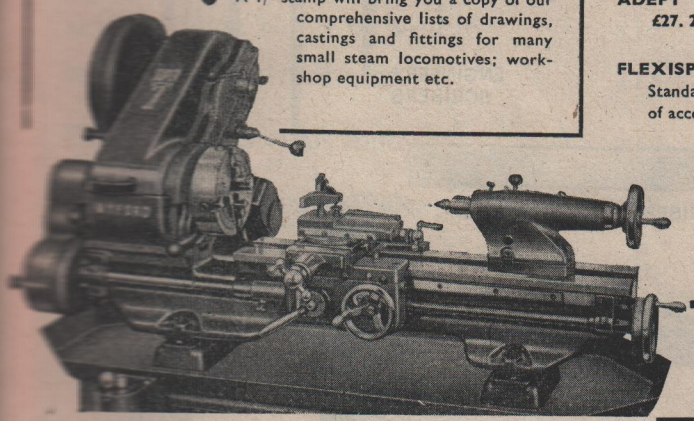

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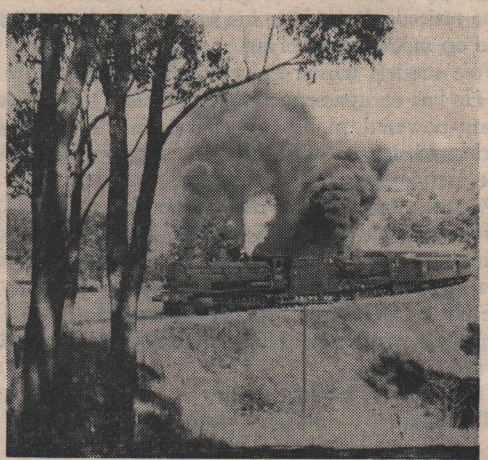


Standard goods engine 2-8-0 *class D53 and passenger engine* 4-6-0 *class C35 hauling the Australian Railway Historical Society's special to Willow Tree. Here it is on the* 1 *in* 40 *gradient at Ardglen in the Liverpool range. More pictures on pages* 118 *and* 119

March 1 issue

Have you ever made a micrometer? Well, you will have the chance. Beginning in the next MODEL ENGINEER, *Martin Cleeve, well known to readers for his workshop articles, will describe in full how this instrument can be constructed*

Subscription 70s. (USA and Canada $10), post free

SMOKE RINGS

A commentary by VULCAN

Oldest model engineer

Is Alf Pinnock, a member of the North London SME, the oldest active model engineer? At the age of 92 I think he has a good claim to that title.

Alf, or Peter Pan as he is often called by his club colleagues, was an Army physical-training instructor and civil servant before he retired. It is since his retirement that he has concentrated on model engineering.

The fine models which grace his workshop testify to his ability. He has two passenger-hauling steam locomotives and two steam-powered model merchantmen. There are other engineering models as well, all fully working and made to the same standards.

Mr Pinnock has been a member of the North London society for many years and his help and advice are respected by the members of this large and flourishing club. As the photograph shows, he still spends some of the day in his North Finchley workshop. At present he is busy on a model of an 0-6-0 Great Western tank. How popular those Western engines are!

Well, what lively nonagenarian is coming along to challenge "Peter Pan" Pinnock?

Mystery of a medal

Mr C. H. Roberts, of San Martin, Argentina, read in the *Buenos Aires Herald* that a medal had been dug up in England bearing an Argentinian inscription and the impression of a Ruston traction engine. He asked if we could give him any further information about it.

When the Editor wrote to Ruston and Hornsby of Lincoln, the press department there sent the only information which they then had—two references in their house journal *Ruston News*. The first reference told how Mr Ray Hooley, librarian at the Ruston research centre, was shown a medallion by Mr Horner, the publican at The Plough, Branston. It commemorated the Argentinian centenary and referred to the Agar Cross Co., Ruston agents in Buenos Aires. According to Mr Horner, the medal had been found on Neesham's farm, Branston, by Mr George Chamberlain, an agricultural worker. It bore the impression of a traction engine and presumably was the one mentioned in the *Buenos Aires Herald*.

The second reference concerned Bernard Ward, a fourth-year apprentice at Rustons. He said that his grandfather, John Curtis, had acquired a similar medal when he was working in Chile.

Who struck it?

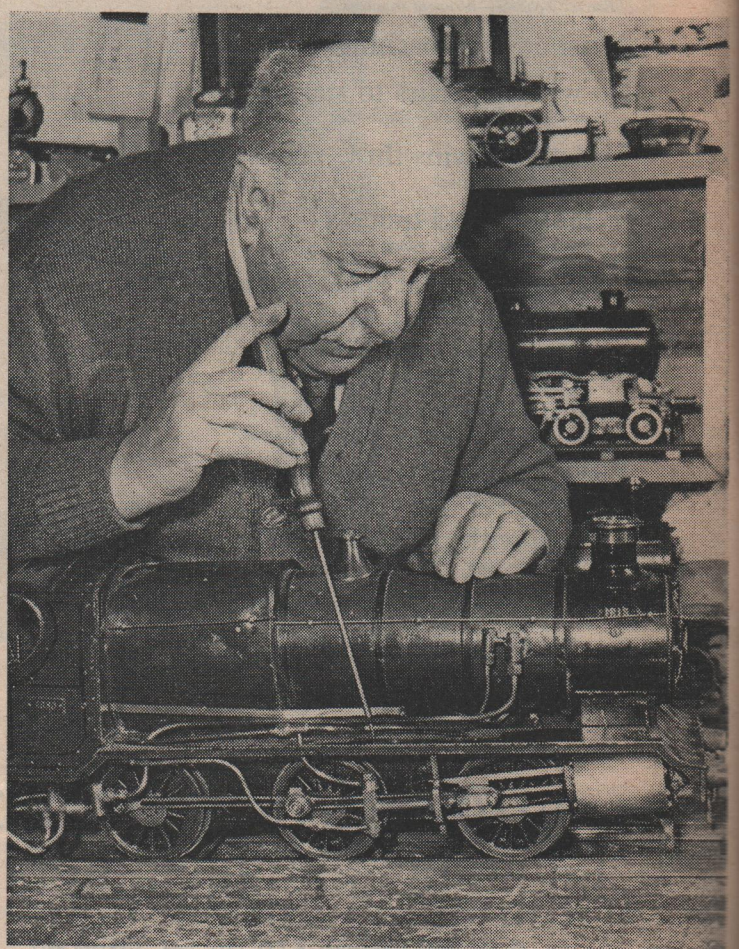
But two questions remained. Who struck the medal? And how could Agar Cross be associated with the centenary when they were not in existence in 1810, at the birth of Argentina?

When Ruston wrote to Agar Cross in Buenos Aires, Agar explained that the medal had been struck by them to commemorate an exhibition held in 1910, at the Rural Society's grounds in Palermo, in connection with the centenary of the Argentine. About 500 of the medals were struck in Buenos Aires for the Agar Cross Co. and were presented to customers attending the Ruston machinery stand. As mechanics from the Ruston factory were present, it seems clear that the medal found at Lincoln was brought back to England by one of them.

And there, Mr Roberts, is the story of the medal which puzzled you.

The gulf

There was a time when the average 3½ in. model engineer's lathe was almost identical to the small ones used in the tool rooms of big industrial undertakings, and in the workshops of many small engineering concerns. But times are changing.



Above: A medallion like this was dug up by an agricultural worker in Lincoln. Vulcan tells how MODEL ENGINEER *traced its history*

Left: Is Alf Pinnock, of the North London SME, the oldest active model engineer? Here he is in his North London workshop

More and more the industrial lathe is becoming specialised. It is a sophisticated version of its former self.

How far, one wonders, will this gulf widen? Will the time come when model engineers will be a unique body of people? Will industry depart so far from the fundamental methods which we were taught as apprentices that today's 3½ in. lathe will be an antique in the director's museum? On the other hand, will the model engineer lathe undergo some revolutionary refinement that will keep it in step with modern industry?

It is an interesting speculation, but there is one thing of which we can be sure—there will always be a demand for the small lathe by men who love to see that swarf curling slowly from the tool edge as they traverse the cross-slide.

Let there be light

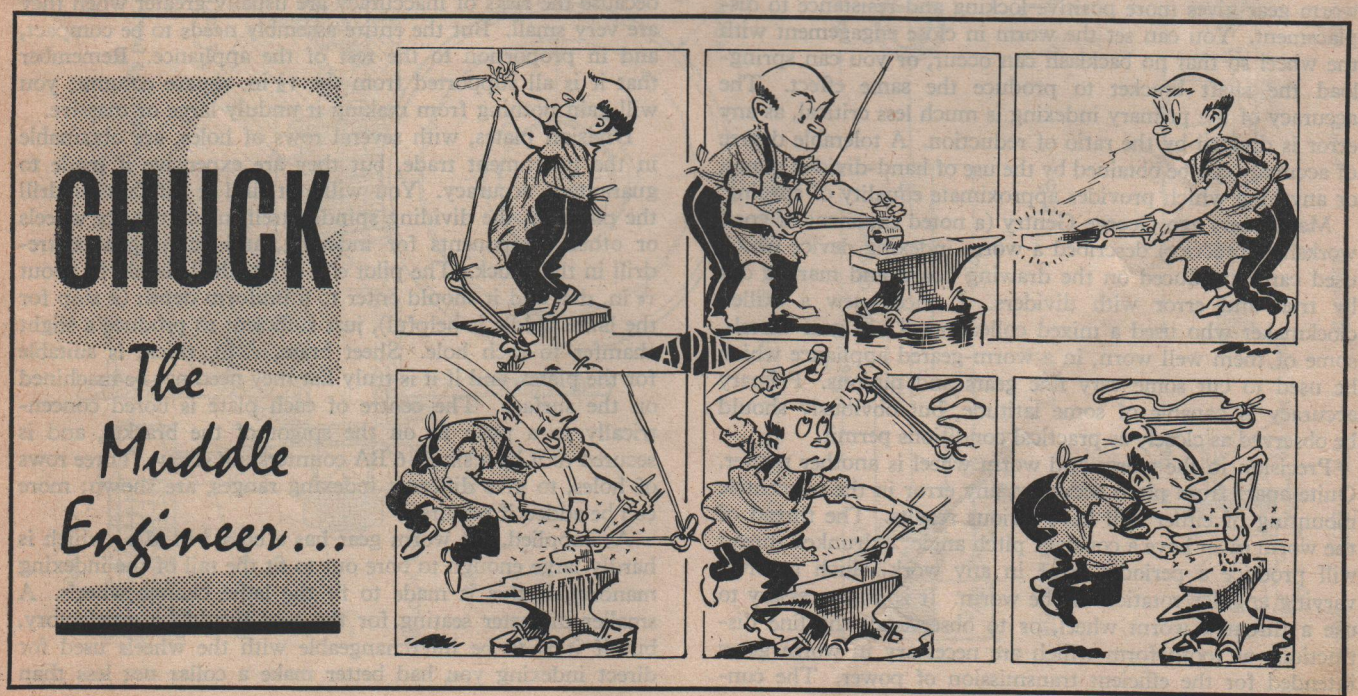
Is the light in your workshop just right? Have you one light over the workbench, and another for general illumination? No? Then it is likely that you are not working in the best lighting conditions.

Let me give you a piece of basic knowledge, kindly passed on to the Editor by Mr L. C. Rettig, a lighting engineer in Glasgow who called at Noel Street this month.

It is this. The light falling on the subject, its immediate surroundings, and the background should be in the ratio of 1:3:10. In practice, this means that, in working with the lathe, for example, the light on the chuck must be three times as great as that on the tailstock and ten times as much as that on the wall or floor.

Mr Rettig says that the best way of fulfilling this condition is to use an adjustable lamp that can be trained immediately on the area of work, with a ceiling light giving general illumination. Even the ceiling light must be carefully placed. It is wrong, Mr Rettig says, to try to work with either light on its own.

Mr Rettig, whose professional interest is in street lighting, has written two workshop articles which ME will shortly publish.



Continued from February 1

By Ned

Indirect indexing with worm gears

THE range of divisions which can be obtained by direct indexing, with the set of change wheels provided on a screw-cutting lathe, or any other accurate gears, will suffice for the requirements of many. But when a much wider range of divisions is needed, the direct or plain indexing gear may prove inadequate. The most practical device then is one which employs a worm reduction gear in conjunction with primary indexing elements such as division plates.

Nearly everyone is familiar with this form of indexing gear. It has been established since the pioneer days of industry. Briefly, it allows a range of indexing to be obtained from a limited number of primary elements through the ratio of reduction provided by the worm gearing. Thus, with a division plate which has 50 equally spaced holes, and a worm which gives a reduction ratio of 60 to 1, the maximum number of divisions obtainable is 60 × 50 or 3,000. You can get any factor of this number by counting the turns of the primary wormshaft, or the number of holes in the division plate, required to make it up. The same applies to any other combination of primary elements and reduction ratios.

For instance, you may want to engrave an index with graduations each representing one degree—360 degrees to the complete circle. This might be difficult with direct indexing, but is quite simple with worm gearing. If you use a 60 to 1 gear and a 60 division plate (a total combination of 3,600), a movement of the primary shaft equal to 10 holes in the plate will produce 1/360 of a turn on the indexing mandrel. It is often found that the worm gear will deal with indexing problems which are almost impossible by the other means which you are able to employ.

Assuming that the gearing is accurate, the final precision of indexing is at least as high as the precision obtained by any method of direct indexing. It is often higher, because the worm gear gives more positive locking and resistance to displacement. You can set the worm in close engagement with the wheel so that no backlash can occur, or you can spring-load the shaft bracket to produce the same effect. The accuracy of the primary indexing is much less critical, as any error is divided by the ratio of reduction. A tolerable degree of accuracy can be obtained by the use of hand-divided plates, or anything which provides approximate equality of spacing.

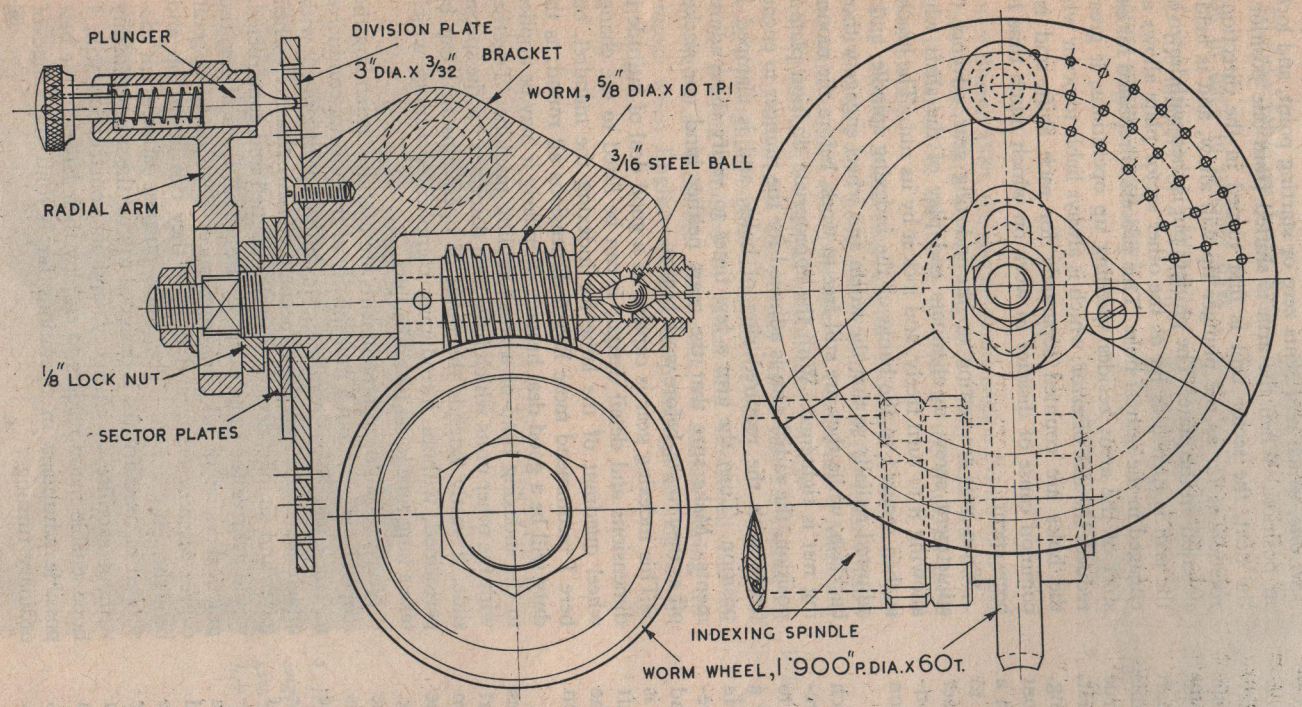
Many years ago George Gentry (a noted exponent of good workshop practice) described a worm indexing device which used cards produced on the drawing board and marked out by trial and error with dividers. I once knew a skilled clockmaker who used a mixed collection of old gear wheels, some of them well worn, in a worm-geared appliance which he used to cut some very fine gears and pinions. Primary accuracy is capable of some latitude, but obviously should be observed as closely as practical conditions permit.

Precision in the worm and worm wheel is another matter. Quite apart from pitch accuracy, any error in the concentric mounting of either will have serious results. The thread of the worm must have a constant pitch angle; a drunken thread will produce a periodic error in any work which involves varying angular rotation of the worm. It is not necessary to use a throated worm wheel, or to observe all the fine distinctions of tooth form which are necessary in worm gears intended for the efficient transmission of power. The contact area between the worm and wheel teeth may be quite small; it is in order to use an accurate spur gear as a worm wheel if the wormshaft is suitably inclined to match the pitch angle of the thread. A slight error in the pitch of the worm does *not* affect the accuracy of indexing, because it will automatically accommodate itself to the pitch line unless it is prevented from doing so by insufficient tip clearance. So long as the meshing of worm and wheel is fairly good, one complete turn of the worm must necessarily advance the wheel by exactly one tooth, no more or less.

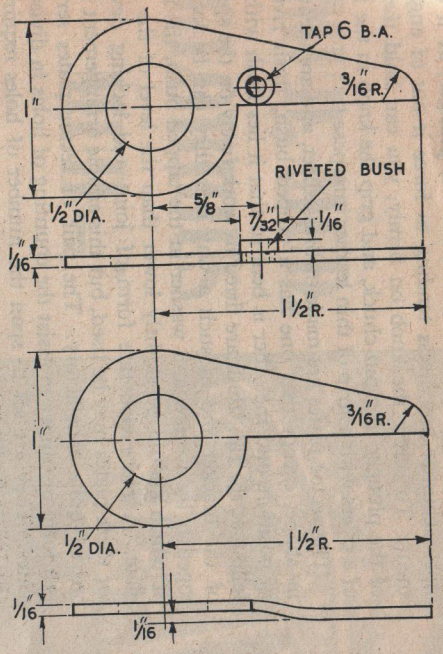
It is not beyond the skill of model engineers to produce both the worm and wheel for themselves. But in view of the importance of these components, most modellers will no doubt prefer to buy them ready-made from a reliable gear-cutting specialist. Two well-known ME advertisers, Bond's o' Euston Road, London, and S. H. Muffett of Tunbridge Wells, Kent, produce a range of worm gears; I have examined samples of their products and can recommend them with confidence. The worm and wheel shown in the assembly drawing is taken from Bond's range, and is about the right size for this purpose. It is, as a general rule, advisable to make the worm gearing and division plates of ample size, because the risks of inaccuracy are usually greater when they are very small. But the entire assembly needs to be compact, and in proportion to the rest of the appliance. Remember that it is all supported from the 1½ in. square column; you will gain nothing from making it unduly large or massive.

Division plates, with several rows of holes, are obtainable in the instrument trade, but they are expensive if made to guaranteed accuracy. You will not find it difficult to drill the plates on the dividing spindle itself, using change wheels or other components for indexing, and running a centre-drill in the chuck. The pilot end of the drill should be about $\frac{1}{16}$ in. dia. and it should enter to a uniform depth (a stop for the lathe saddle is helpful), just sufficient to produce a slight chamfer to each hole. Sheet brass, $\frac{3}{32}$ in. thick, is suitable for the plates, and if it is truly flat they need not be machined on the surface. The centre of each plate is bored concentrically to a push fit on the spigot of the bracket, and is secured to it by a single 6 BA countersunk screw. Three rows of holes, to give different indexing ranges, are shown; more can be added if required.

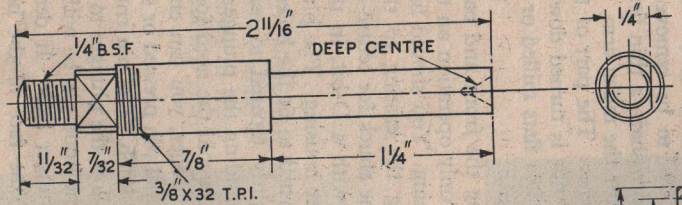
As supplied, the worm gear has a boss $\frac{3}{4}$ in. dia., which is hardly large enough to bore out to fit the tail of the indexing mandrel, if this is made to fit the lathe change wheels. A smaller diameter seating for the gear would be satisfactory, but if it is to be interchangeable with the wheels used for direct indexing you had better make a collar not less than



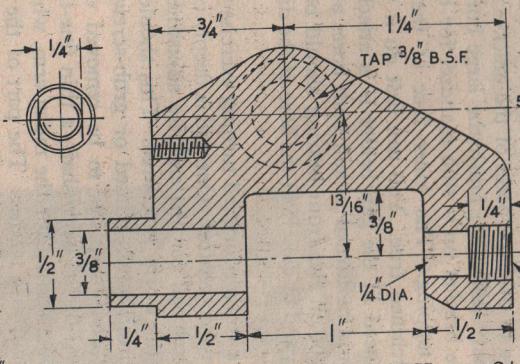
WORM INDEXING GEAR ASSEMBLY



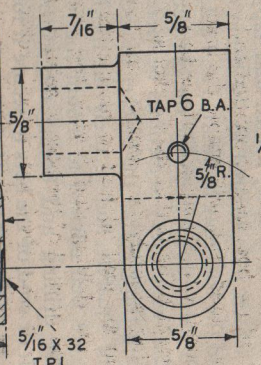
SECTOR PLATES 1 OFF EACH BRASS

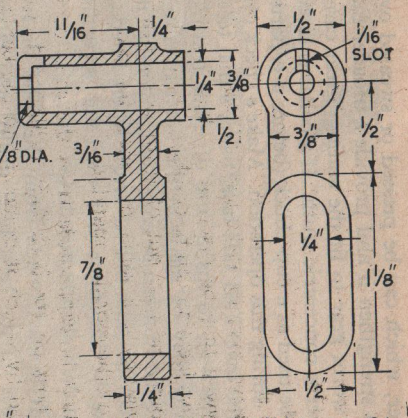


WORMSHAFT 1 OFF M.S.

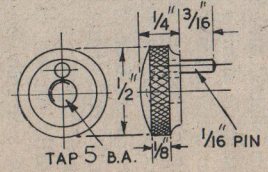


WORMSHAFT BRACKET 1 OFF C.I.

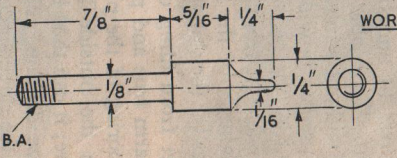




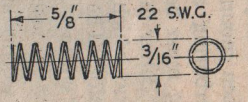
RADIAL ARM 1 OFF C.I.



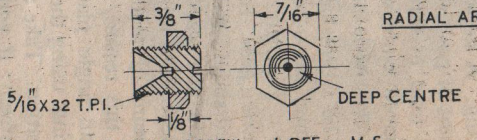
KNOB 1 OFF M.S.



PLUNGER 1 OFF M.S.



SPRING 1 OFF SPRING STEEL



ADJUSTING SCREW 1 OFF M.S.

1 in. in diameter, which can be pressed or sweated over the existing boss to strengthen it and provide a broader face. In boring out the worm gear to fit the seating, great care must be taken to preserve concentric truth. If a collar is fitted over the boss, it can be used as a cup chuck (before it is parted off) to hold the gear during this operation. Make a check over the gear teeth and the machined side face, using a dial test indicator if you have one, to make sure of exact truth before boring. A keyway may be made in the bore, or any other means of positive location can be employed, so long as it does not tend to force the gear out of truth when fitted. It is clamped endwise by the same nut used for securing the change wheels on the indexing mandrel.

The wormshaft bracket, made from the solid or from a casting, has a boss on the back face, drilled and tapped to take a $\frac{3}{8}$ in. stud by which it is secured to the banjo of the indexing gear. Instead the boss may be omitted and a double-ended shouldered bolt used; this will enable the bracket to be fitted either way round, which may sometimes be more convenient. The important thing is that the bracket should have a means of mounting squarely and securely on the banjo. For this reason, you are well advised to mount the bracket on an angle plate for drilling and boring the wormshaft bearing, using the bolt or stud of the boss to secure it for this operation. Take care to drill the bores of the bracket in true alignment; if you have difficulty, finish the large bore first, and then mount the bracket on a stub mandrel for boring, counterboring and tapping. The inner face of the front bearing must be machined true. You can best do it with a facing cutter introduced in the gap before it is attached to its arbor, which should be turned to suit both bores and act as a pilot. The spigot on the front bearing should be concentric with the bore, and fit closely in the bore of the division plates.

The wormshaft is a straightforward turning exercise which can be carried out between centres. One end is deeply centre-drilled to take the steel ball for the endwise adjustment, to eliminate play when the worm is secured. This should be a light press fit and firmly cross-pinned or grub-screwed in position. To enable division plates to be removed or replaced without removal of the wormshaft, a thin fine-thread nut is used to provide a seating for the radial arm, which is clamped by the end nut and washer. The part of the shaft immediately in front of the thin nut is turned down to the root diameter of the thread, and has flats milled or filed on the sides for the slot of the radial arm.

Apart from filing or machining the front and back faces of the arm true and parallel, the only operation on this part is the boring of the plunger housing. You should first skim this on the outside by clamping the casting to the lathe faceplate; it can then be held in the chuck for centre-drilling, undersize drilling, and finishing with a D-bit, in the same way as the direct-indexing plunger housing. The plunger is similarly fitted, but the end is turned to fit the holes in the division plates, and may be slightly tapered to assist engagement. A similar method of holding the plunger out of engagement may also be used. To avoid the need for cross-drilling the slender stem of the plunger, you can employ a device consisting as shown of an axial pin pressed or screwed into the inner face of the plunger knob. The pin enters the slot in the end of the housing to allow the plunger to engage the division plate; at other times the knob can be withdrawn and partly rotated to hold the plunger back. If desired, a shallow slot may be provided in the face of the housing, opposite the deeper slot, to make disengagement more positive. Only a light spring is required for the plunger, as it does not encounter any stress tending to force it out of engagement. To screw the knob on firmly, you can hold the tip of the plunger in a pin chuck, and grip the knob in the jaws of a pliers with a strip of thin leather interposed.

The sector plates are made of brass sheet, and are identical in shape, except that one has a tapped bush, flush riveted in position, and the other is bent so that it lies flush with its fellow at the tip. Both are fitted to work freely on the spigot of the bracket and in such a way that they can be locked together by a screw and washer in the tapped bush, the face of which should be slightly lower than the level of the top plate. A more elaborate form of joint and locking device for these plates may be used, but this simple arrangement has proved quite satisfactory. The pair of sector plates serves as a form of caliper to assist the counting of holes in division plates. They are set to span the number of holes required, *plus one*, which represents zero or starting point, and locked in position. When the arm is shifted from one position to the next, the sector unit is first turned in the direction of rotation as far as the plunger tip will allow, and is held in position on the plate. The plunger pin is then withdrawn and the arm is turned as far as the other sector plate allows and engaged in the nearest hole. This process is repeated for each shift of the arm; besides speeding up operations, it greatly reduces the risk of error, which is always liable to occur when the holes are counted separately for each shift, and is a common cause of disaster in work on which much time has been spent.

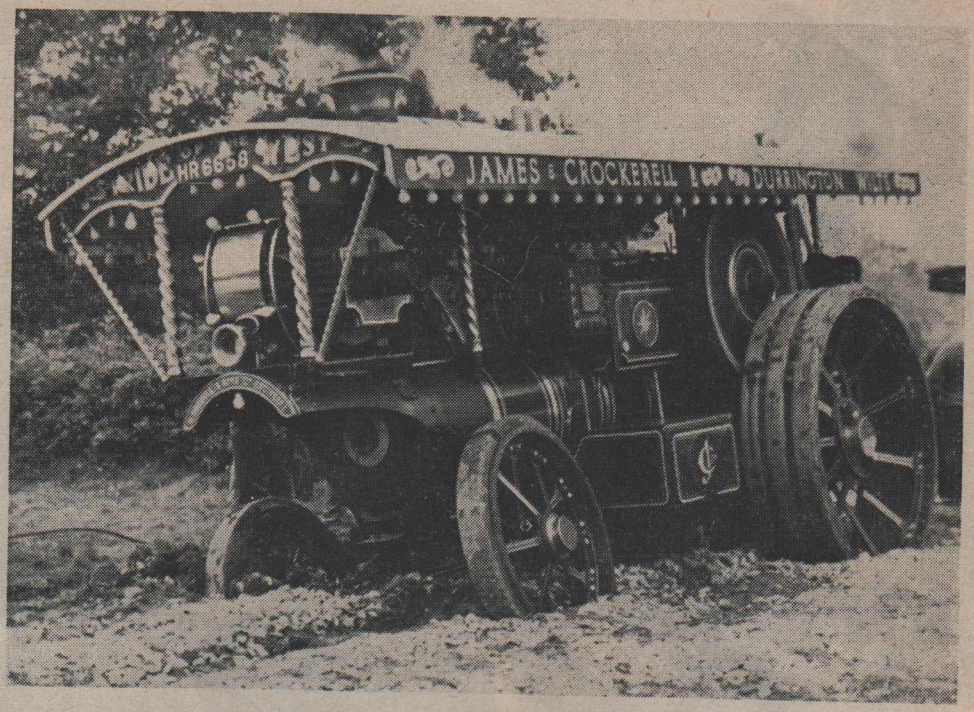
When you are setting up the indexing gear, advance the adjustment screw to eliminate end play of the shaft while allowing it to turn freely, and lock it by its nut. The bracket is then secured to the banjo of the indexing spindle, and is adjusted radially so that the worm and wheel engage without backlash, while they are still free to work, before the mounting nut is tightened. With the appropriate division plate in position, the radial arm is adjusted for the plunger to engage freely with the required ring of holes, and is clamped in position. Turn the arm a few times to verify these adjustments. Make sure that the gears neither bind nor slacken off as they rotate, before work begins.

This indexing gear is capable of a good deal of latitude in dimensions and detail design; it can be fitted to the change wheel quadrant of the lathe for indexing the mandrel, but here I recommend more liberal dimensions all round, as the duty will be a good deal heavier. Similarly it may be applied to the indexing head of a small milling machine. Together with the other units which have been described for the special slide, it vastly extends the range of operations that can be performed, without introducing complicated fittings which take a long time to set up and adjust.

Nearly all kinds of attachments are useful in extending the scope of the lathe, but a multiplicity of them is not conducive to efficiency. We sometimes see lathes so decorated with attachments as to look like a mechanised Christmas tree, when fewer and simpler devices, if well designed and constructed, would achieve the same purpose. But apart from utility, the practical value of all such appliances depends in a great degree on how easily and quickly they can be set up and brought into action. The multi-purpose attachment described in these articles is designed to give the utmost facility without sacrifice of efficiency, and its construction will, I hope, enable many readers to employ their lathes to the best possible advantage in operations far beyond the range of ordinary turning. ▣

'MUD, MUD, GLORIOUS MUD—'

In fill-dyke February E. G. Best takes us back to summer days with the memory of a Wiltshire traction engine which stuck



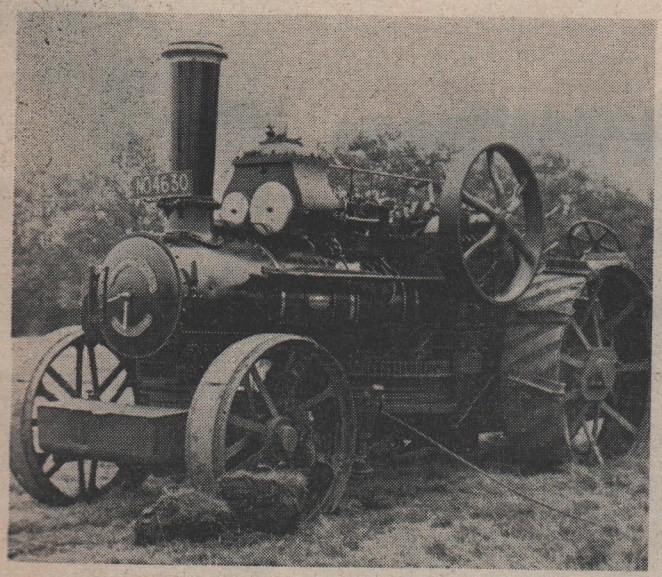
WHEN Burrell 3887, the special scenic engine *Prince of Wales* (Pride of the West), was turning into a rally field near Newbury in Berkshire, she came to grief in the mud, as these pictures show.

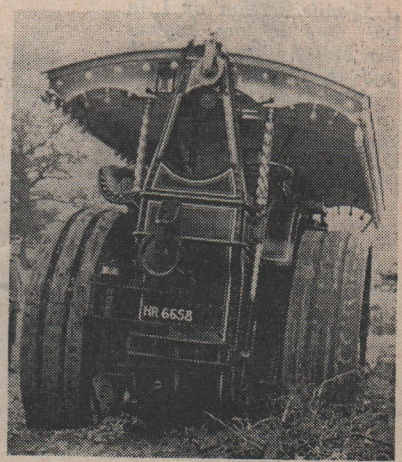
The Fowler ploughing engine No 14712 went to her rescue and dug up a good deal of mud with her front wheels. Two other engines took part later: a Fowler and a Marshall, both of them single-cylinder machines of 7 n.h.p.

It is not often that the general public has the chance of seeing a ploughing engine doing useful work.

The Burrell belonged to James and Crockerell Ltd of Durrington in Wiltshire. She stuck, of course, during the summer when English mud is deep enough to bog down anything. ▣

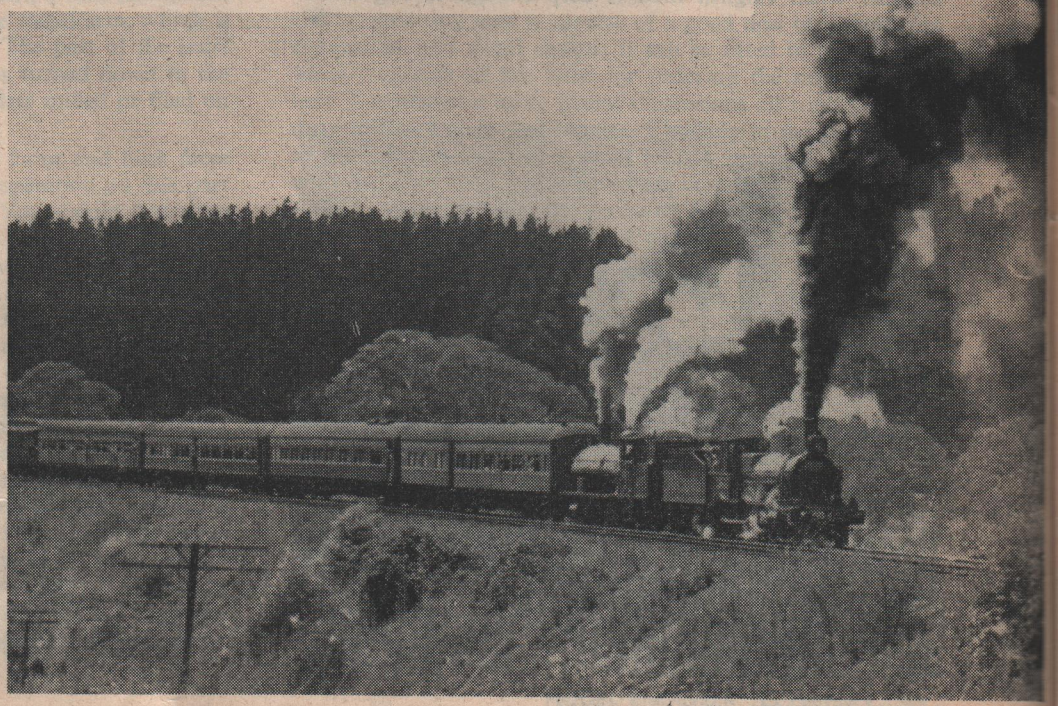
What will they do now'?





Left: Fowler ploughing engine, born for mud, is given a chance to show her great pulling power

Above: Last steam run on the branch line from Tarana to Oberon in March of last year. The train consisted of six old compartment carriages and two Z 219 0-6-0 inside-cylinder tender engines. Here the train is taking a 5½-mile section of 1 in 25. One of the engines was built by Beyer Peacock and the other by Henry Vale of Sydney, about 1877 to 1880. The terminus of the branch at Oberon is 3,600 ft above sea-level

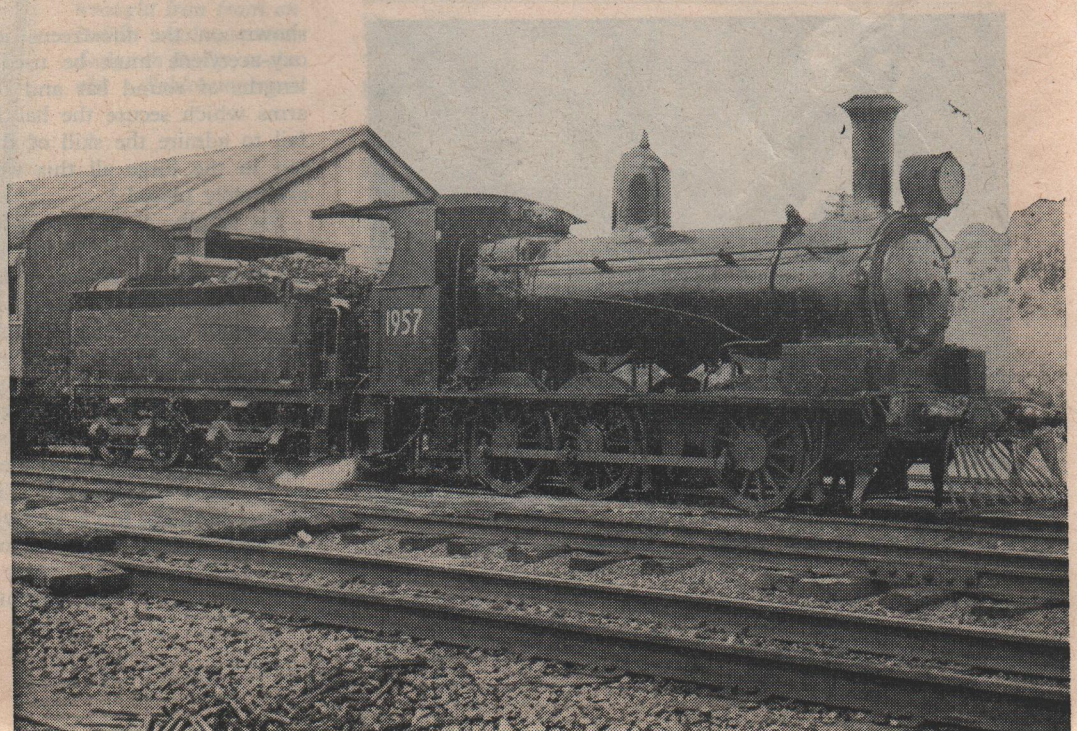


Near Rydal. The two engines worked the train from Wallerawang to Tarana, about 20 miles. No 1709, the leading engine, is a Z 17 4-4-0 built by Vulcan Foundry as an H class in 1884. The other is a 226 class 2-6-2 which came from Dubs & Co., of Glasgow, in 1896

Near Singleton, about 150 miles north of Sydney, on a trip of the Australian Railway Historical Society to Merriwa and Willow Tree, in the September of 1962. No 1243, a 4-4-0 with outside cylinders, was built by Atlas Works, Sydney, in 1884. Behind her is No 3344, a 4-4-0 which left the Beyer Peacock Works at Manchester 63 years ago and is still in service. On the 550-mile journey of two days, engines were changed

HONOUR IS PAID TO STEAM IN NEW SOUTH WALES

Two days of travel, 550 miles to go... There is high enthusiasm in Australia for the old engines that played a part in the pioneering of a great country



Introduction to Wrought Ironwork:

Continued from February 1

How we fashion the

By Austin Underwood

MUCH of the wrought ironwork made in school will require a handle of some kind. In magazine racks, pokers, hearth shovels, tongs and so on, the handle is some intrinsic part of the design or can be simply formed by the twisting, curving or scrolling of the metal as in some of the designs already described.

The making of a handle which is pleasing to look at and comfortable to hold should be left to a more advanced stage in the progress of the young smith. Such is the cage handle shown on the firescreens in an earlier instalment. Here oxy-acetylene must be used for welding together the six lengths of round bar and for the later welding-on of the arms which secure the handle to the frame. How can we fail to admire the skill of the old-time smiths who carried out in the forge all this welding of parts that had to be accurately placed ?

Fig. 1: Making a cage handle. The six rods are welded together with the separators at each end. Right, Fig. 2: After having been heated bright yellow, the welded bundle is twisted and hammered to expand the cage

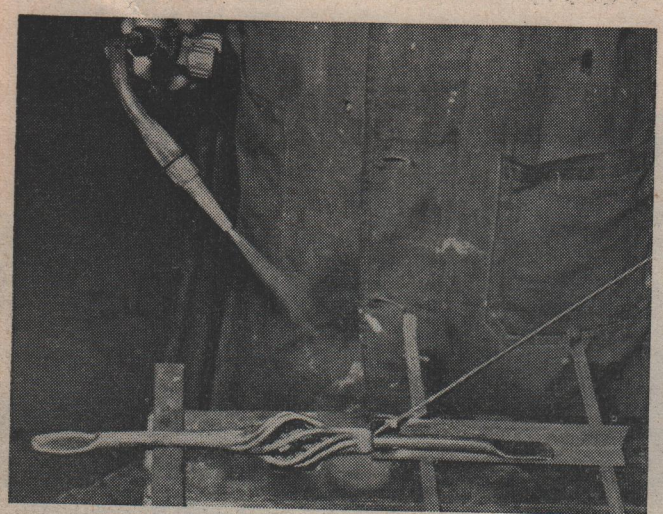


Fig. 3: Welding the ends to the cage to form the handle

Six lengths of $\frac{1}{4}$ in. or $\frac{3}{16}$ in. diameter rod are sawn off to the length required for the handle, and a $\frac{1}{2}$ in. long piece of the same metal is placed at each end of a bundle made of the rods. The bundle is bound with soft iron wire and the ends are welded together as shown in Fig. 1. Before the general welding together, the ends of the rods should be tacked to the central $\frac{1}{2}$ in. long spacing pieces.

The whole is heated in a gentle broad and clear fire while the bundle of rods is turned over and over for even treatment. It is then removed and gripped firmly in the vice as in Fig. 2, no vice clamps being used. With one end firmly held by a pair of gas pliers, the top is gently and evenly twisted. The whole is returned to the fire, a second heat is taken, and the twisted

handle

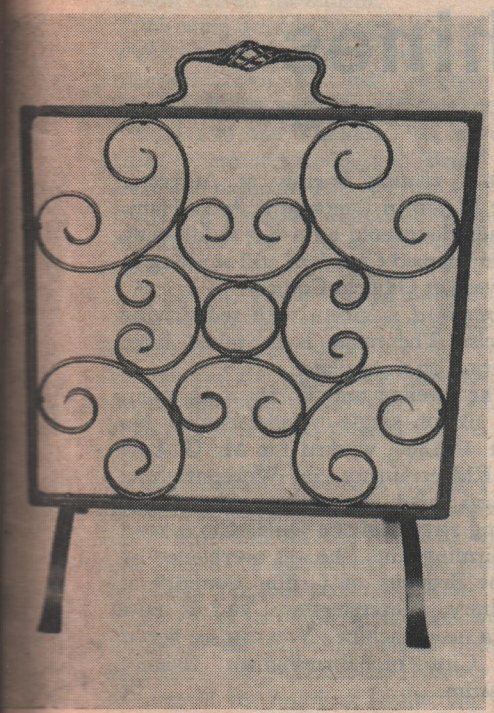
Fig. 4: Shaping the weld with the oxy-acetylene flame. Brushing removes the need for a lot of filing

handle is held as before. This time we hammer it downwards (Fig. 2), twist it outwards, employing the gas-pliers to make any correction for equal bellying of the twists.

We clean the ends of the welds with a file when they are cold. The supporting arms for the handle are made as in Fig. 3, which also shows how the whole is set up on the anvil for the welding-on of the arms. Each weld is brushed with the oxy-acetylene flame as in Fig. 4 so that the joint is as regular as possible and will need little filing.

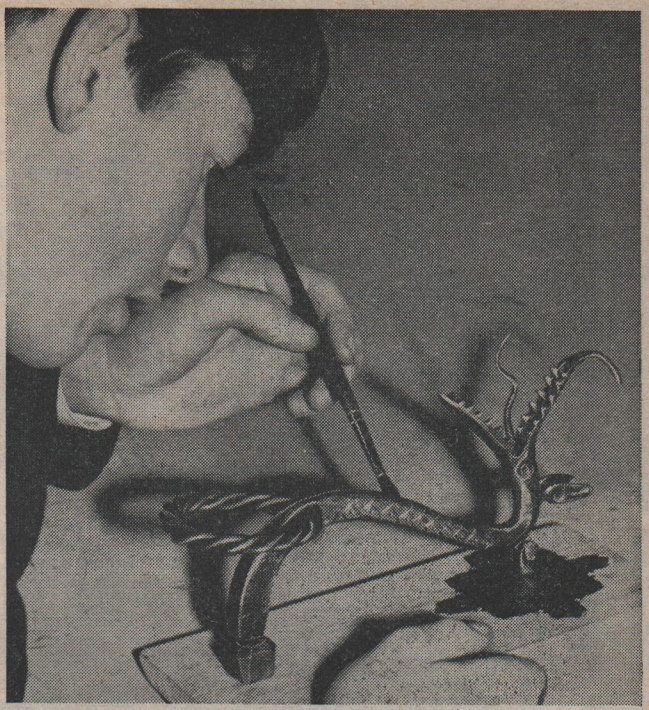
The arms of the handle are then aligned, bent to shape, and drilled for riveting to the frame.

Throughout all the work which I have described, it is extremely important that, apart from good design, careful



Roy Wort, aged 15, of Bishop Wordsworth's School at Salisbury, lacquers the dragon door-knocker which he made in bright-finish wrought iron from an Italian quinquecento design in Berlin, at the old Schlossmuseum

Firescreens are ideal subjects for wrought ironwork. This one is particularly pleasing



laying-out and accurate bench work, the technique of using the forge should be thoroughly mastered. The points which I mentioned in the introduction cannot be over-emphasised. Begin with a clean fire, free from ash and clinker. Keep it well made up with good fuel, restrict it to the centre by damping the edges, and limit to a minimum the length of time that the iron stays in it. I do not mean that we should work at as low a temperature as possible. On the contrary, a good yellow heat is necessary for most processes. But if several heats are needed, take care not to allow a hard coating of brittle oxide to be formed by thin fires. Such a coating will be found very difficult to remove in the cleaning processes.

The classic guide is *A Handbook of Wrought Ironwork*, by Hoever (Thames and Hudson). Other books which I recommend are *Wrought Ironwork, The Blacksmith's Craft* and *Wrought Iron Design Catalogue* (Rural Industries Bureau, all three). ▣

Festiniog success

THE wet summer of 1963 hit the North Wales tourist trade, but it had no adverse effect on the passenger traffic of the Festiniog Railway.

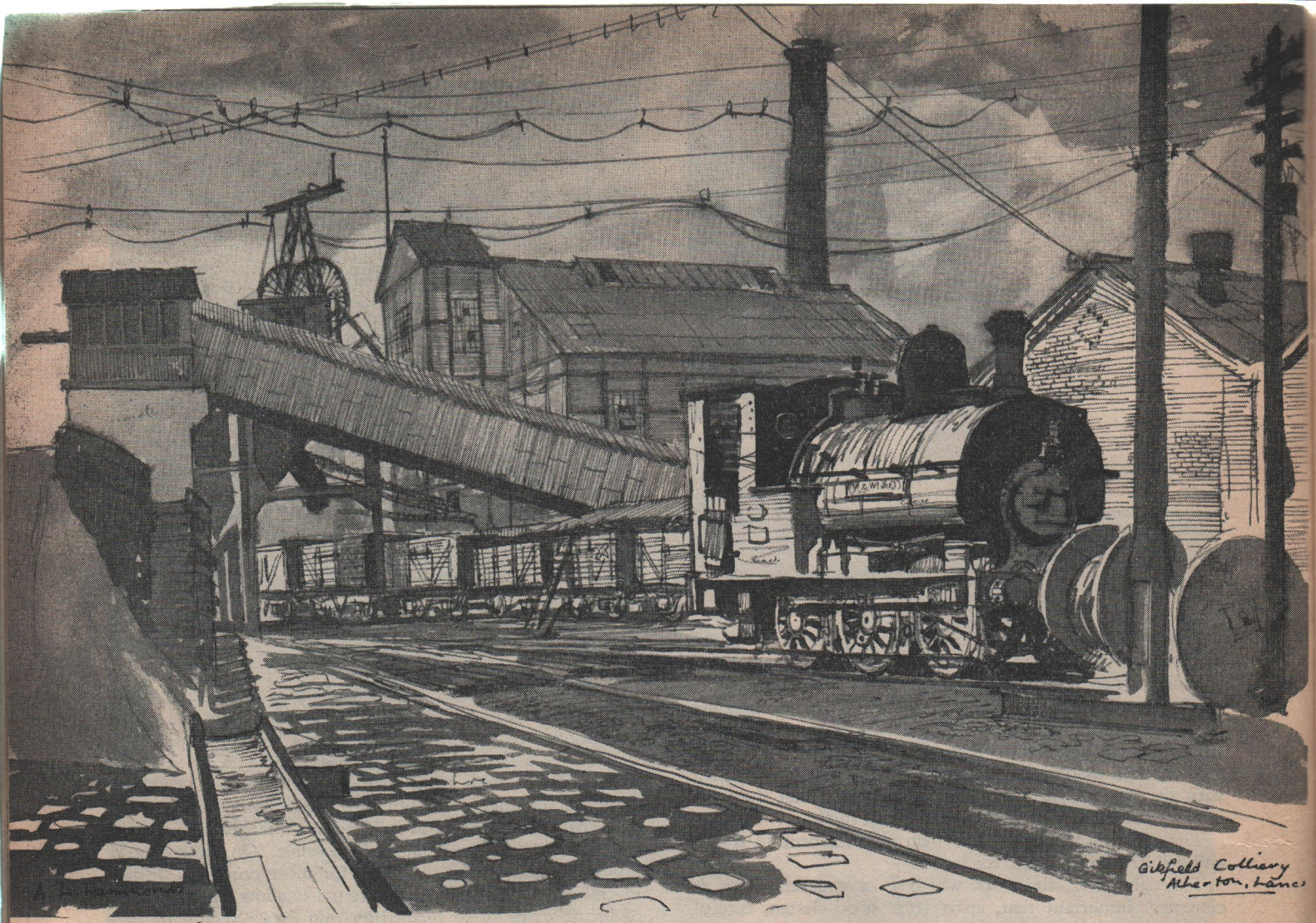
In fact, their receipts were up on the previous year, with an increase of 15,000 passenger journeys.

Mr A. G. W. Garraway, writing in *The Festiniog Railway Magazine*, says that "there is ample evidence that the increase was the result of our sustained publicity efforts." Yes, indeed, it pays to advertise.

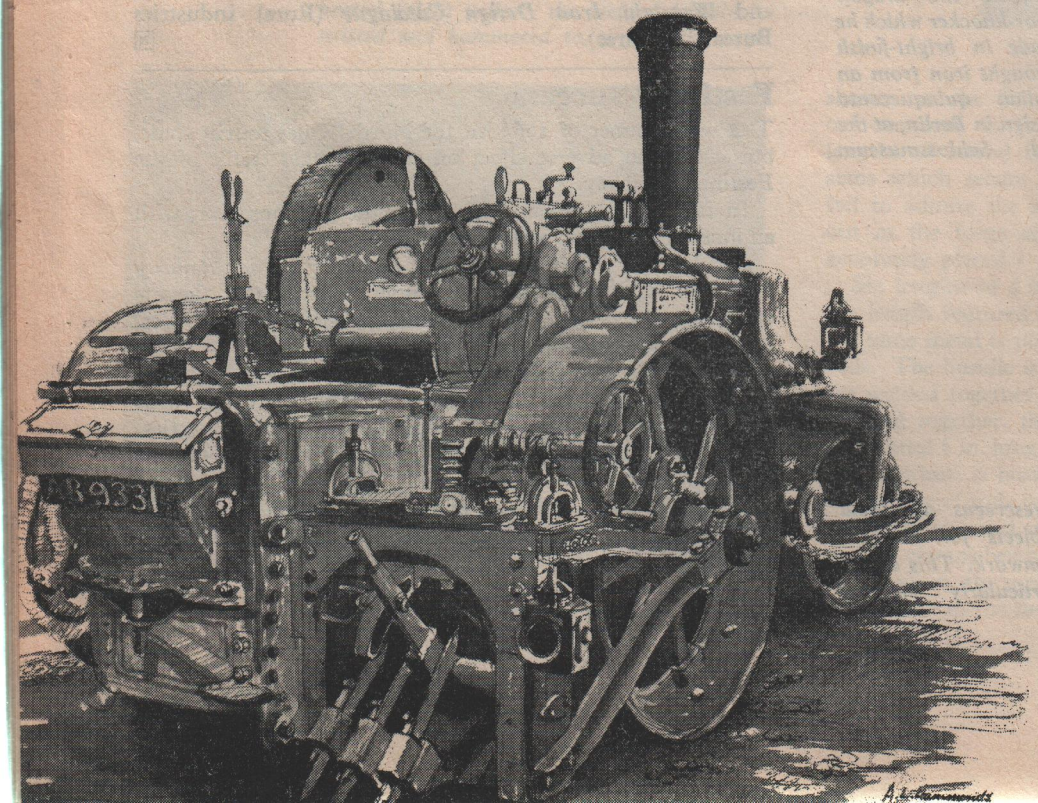
Only minor troubles have been experienced with the three working locomotives. *Linda*, which was purchased with *Blanche*, her sister engine, from the Penrhyn Quarries, proved of great value and worked most of the end-of-season trains.

Several specials were run in October, including a double buffet excursion operated in connection with the Festiniog staff dinner.

L.B.H.



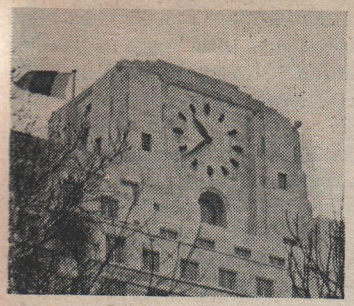
Artist among machines



WHILE visiting friends at Atherton, near Bolton in Lancashire, A. L. Hammonds discovered an 0-6-0 saddle-tank engine named *Crawford* still working in the yard at Gibfield Colliery.

Crawford is green, with red driving wheels. The name is in raised brass lettering on a red plate.

The Aveling and Porter road roller, is a six-ton single-cylinder engine, No 9331 of 1890, worked for Mr G. Law of Kidderminster in Worcestershire. It was used in making City Road, a long stretch of the Outer Circle road at Birmingham. She was overhauled by Hunt Brothers of Griffin Foundry at Oldbury, Worcestershire, and is now like a new machine. You can see her at the City of Birmingham Science Museum. ▣



The GREAT CLOCKS of LONDON

Continued from February 1

After climbing like a lighthouse keeper to explore the workings of Big Ben, J. H. Wilding is whisked to the top of Shell-Mex House

No winding stairs to stagger up this time!

THE clock on Shell-Mex House has the largest dials in London—23 ft 3 in. in diameter, 9 in. bigger than Big Ben. It is difficult to take the comparison with Big Ben any further because the two movements are entirely different. Although the Shell-Mex House clock is still weight-driven, it is controlled and released every half minute electrically by a master clock; hence the description, "a half-minute release, weight-driven movement."

We were quickly brought to roof level in the elevator, and while waiting for our guide, Mr Davis, who looks after the maintenance of the clock, we enjoyed the view of London. The clock has two dials facing north and south over the Strand and the Thames. We were able to see both dials from where we stood, and Brian Western took a picture from the parapet. I have often seen the South dial from the river. As I walked along the Strand I kept looking for the North dial, but it is set too far back to be seen from the road.

When Mr Davis arrived we were let in through the glass door, which can be seen on the right hand side of the tower in Fig. 2. After picking our way between the enormous lift motors and the air conditioning machinery and other equipment, we came to the clock room. This is much smaller than Big Ben's, a bare 10 ft square. It is lit only by electric light.

Westminster Tower was built as a clock tower especially to house a large clock. Priority was given to the housing of the movement and all the parts of the mechanism. Nothing else had to be considered. But most clocks have to accept far more humble accommodation. No one can expect an architect to provide a vertical shaft running the whole height of the building just to house some large lumps of cast iron and steel cables. Neither can space be spared at the top of the building so that the clock movement may be

Fig. 2: The Shell-Mex clock floodlit

Fig. 1: View from the roof balcony

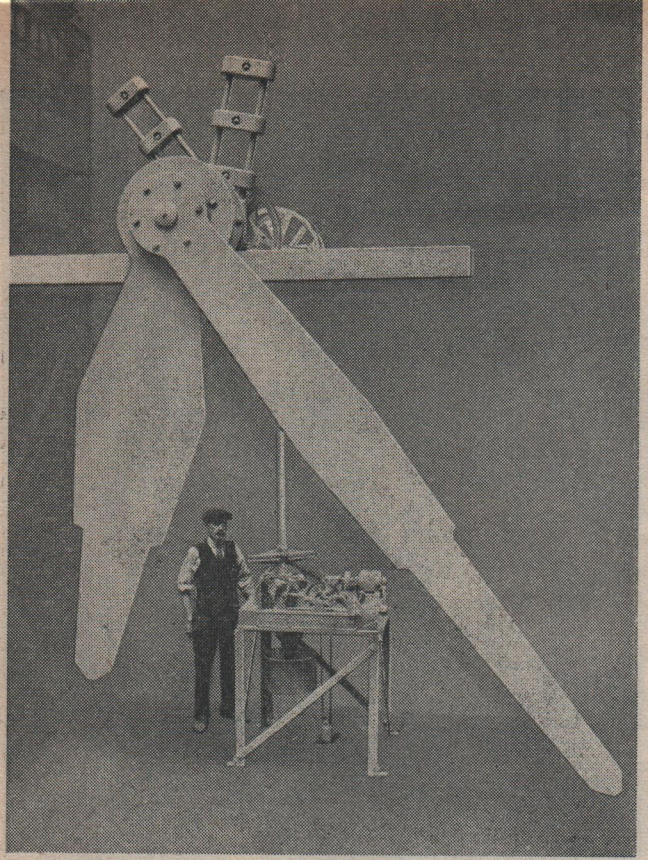


Fig. 3: Testing the movement and hands in the factory of Gillett and Johnston

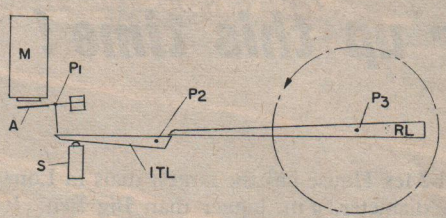
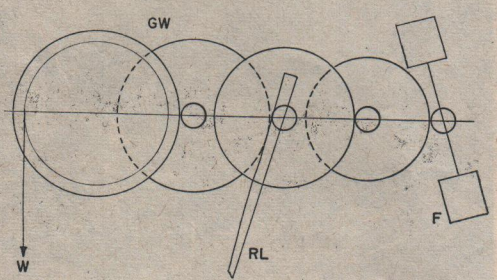
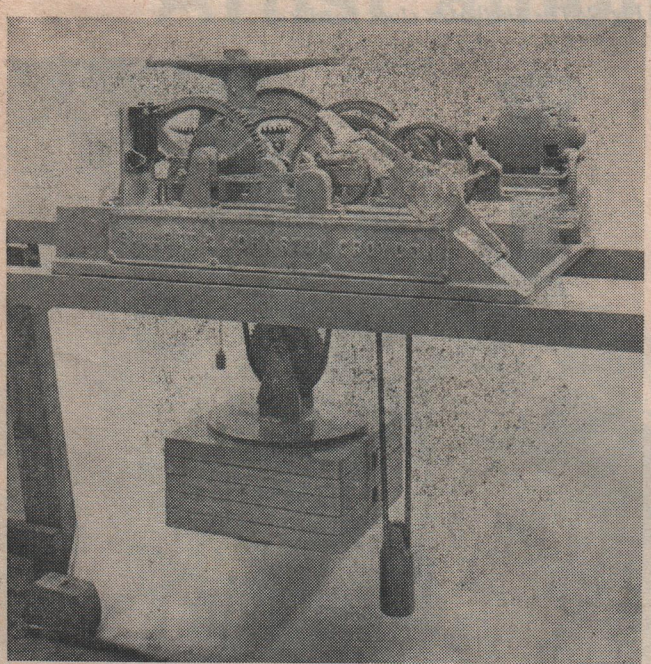


Fig. 6: Release mechanism. P *pivot points,* M *magnet,* A *armature*



Left, Fig. 5: Simple train



Below left, Fig. 4: General view of the movement

put on a pedestal in the middle of a room ! Like most other things, clocks have had to take up as little space as possible and to work with little attention. Not many firms or institutions would allow the twelve hours of maintenance which Big Ben receives each week.

The Shell-Mex clock was built by Gillett and Johnston, an old-established and well-known firm.

I have made two simple drawings to show the movement (Figs 5 and 6). In Fig. 5 you see a simple train of gears culminating in a fly. The third wheel carries the release lever which is allowed to rotate at half minute intervals, controlled by the master clock. The last arbor carries the fly which controls the speed in exactly the same way as a striking or chiming train. The fly has a pawl and ratchet arrangement so that it can continue to rotate after the train has been halted.

Fig. 6 shows the release mechanism. As in the diagram, the train is halted and waiting for the half-minute impulse from the master clock. The solenoid *M* is usually in the circuit together with any other impulse dials in the building. But the master clock is separate. Gillett and Johnston no doubt thought it would be safer to isolate the mechanism from any faults which might develop in a large circuit of dials. The master clock, made to Gillett and Johnston's own design, is in the clock room with the movement itself. It is run from a battery of dry cells.

As soon as magnet *M* is energised, the armature *A* is attracted to it, releasing the intermediate tripping lever *ITL* and allowing it to rotate in a clockwise direction under the pressure of the release lever *RL*. This lever can now begin to rotate anti-clockwise for a full revolution, permitting the clock to advance half a minute. It takes about 20 seconds to do this.

The intermediate tripping lever, when the release lever has passed its tail, will fall down on the stop *S* and the armature will reset itself. Fig. 7 illustrates the release lever waiting to be let go. In Fig. 8 it has disappeared from sight. Two springs mounted on the top of the release absorb the shock when the lever is stopped by the tail of the lever *ITL*. The lever *RL* is not fixed rigidly to its shaft.

Fig. 9 shows the method of winding. The clock is automatically wound by a mains driven ½ h.p. electric motor. With the Huygens endless-belt method, the great wheel (the name usually given to the first wheel in a clock train) is always under power even when being wound and so there

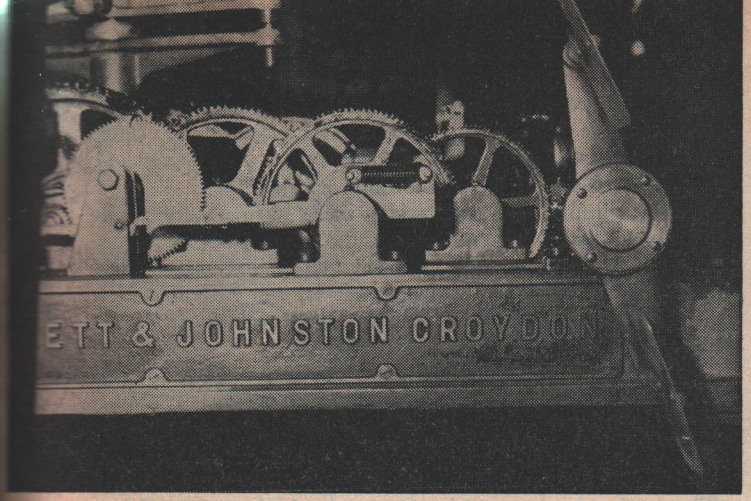


Fig. 7: Normal or halted position of the release lever

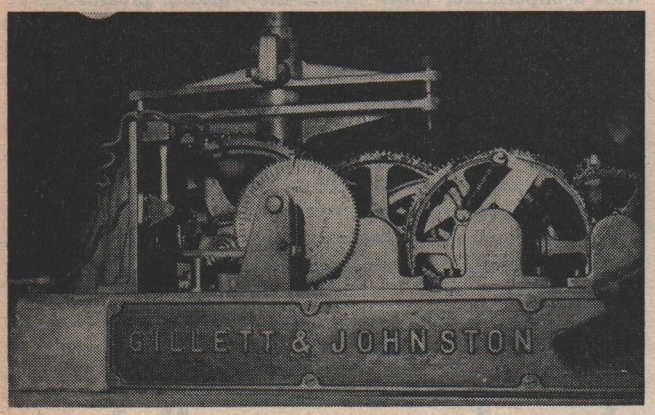
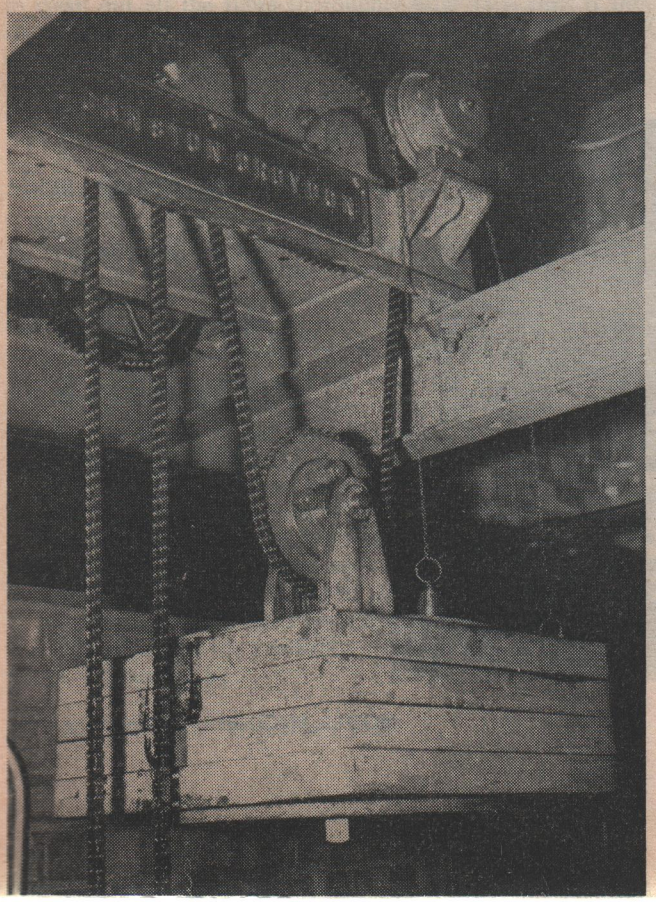


Fig. 8: Just after release

Fig. 10: Quarter-ton weight and mercury switch



is no need for any maintaining mechanism or any ratchets and pawls. Instead of enormous winding barrels with yards of wire cable, only a short length of Reynolds chain is used and the fall of the weight is restricted to 18 in. or so.

A mercury switch, seen at the top right of Fig. 10, automatically switches on the motor. The switch is opened and closed by the two small weights on the end of a short length of chain. As the main driving weight descends, it takes with it the little cone-shaped weight resting on it. The rise and fall action of the chain opens and closes the mercury switch about every nine or ten minutes.

Should there be a mains failure, or should the electric motor fail to wind the weight for any reason, the weight can continue to fall for a period of half an hour. But as soon as it passes the place where it would normally have operated the mercury switch, it comes into contact with another switch which works an alarm bell in an office downstairs. There is always someone on duty in Shell-Mex House, and when the bell sounds a duty engineer goes to the clock room and winds the weight, using the handle shown in Fig. 11, until the current is restored.

A further safety device protects the mechanism from a

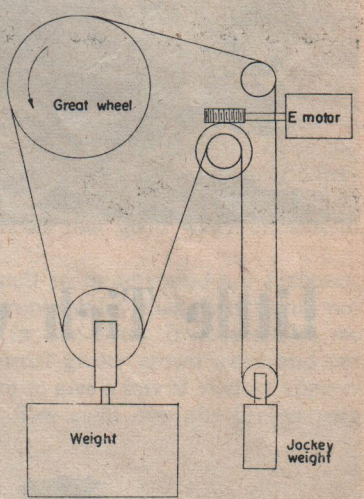


Fig. 9: Method of winding

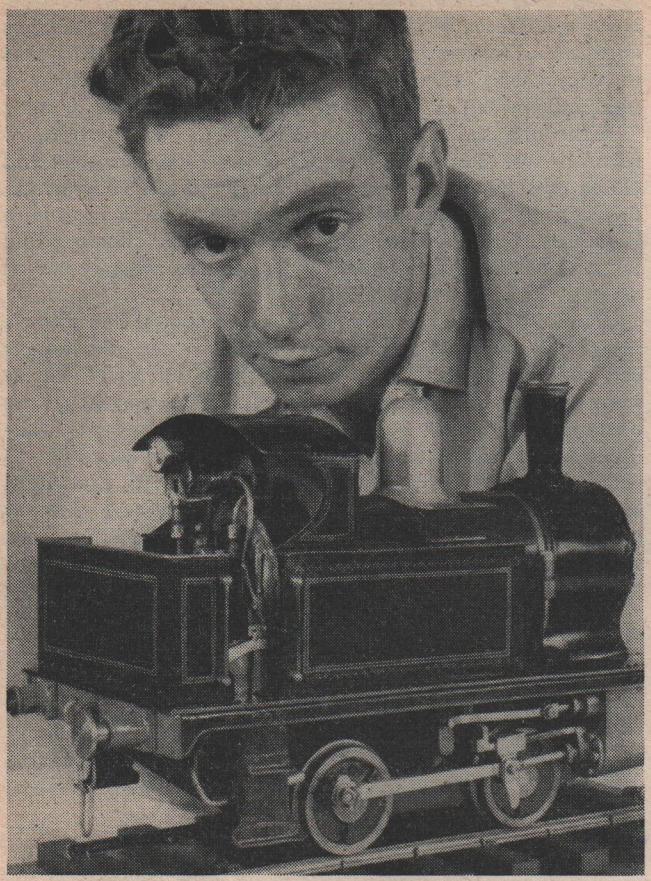
failure of the mercury switch. If the switch failed to open at the finish of winding, the weight, as can be seen from Fig. 10, would eventually come into contact with the clock frame and then something would have to break. To prevent this trouble, the electric supply lead to the motor travels by way of a plug fixed under the weight itself. If the weight rises beyond the correct distance, the cable becomes tight and the socket plug under the weight simply pulls out, disconnecting the supply to the motor. A spare motor is kept in the clock room, and the two are changed at regular intervals for overhaul.

To be continued

The following plan is now available:

L.O.45 BOXHILL

SHEET 4 (Reversing and lifting arms, reach rod, weigh-shaft, reversing gear in cab, crosshead pump, lubrication arrangement, oilbox for axleboxes and slide bars, front elevation of valve gear, arrangement of oil delivery to cylinders, oil check valve). Price **5s. 6d.**



PETER CAULEY, a 20-year-old apprentice fitter with ICI, has won three prizes in a single competition with *Little Tich*, the locomotive described in ME sixteen years ago. The awards were given by the ICI Alkali Division which sponsors an annual Arts and Crafts Exhibition for its staff.

Besides winning the first prize—there were 93 entries—Mr Cauley gained top marks for the best entry by competitors under 21 and was awarded first prize for the best working model. With his prize money he will further equip his little workshop (a garden shed). He already has a 3½ in. × 20 in. lathe.

His engine is the first model that he has made since he first took an interest in model engineering three years ago. It has power enough to pull his brother and himself on their 3½ in. gauge track in the garden. Walschaerts gear and brake blocks have yet to be added.

The engine is about 16 in. long, 9 in. high and is 6½ in. wide. Its two cylinders are ⅛ in. bore × 1⅛ in. stroke. The copper boiler contains twelve boiler tubes ⅜ in. dia., together with a superheater tube. While the working pressure is 80 p.s.i., the boiler had withstood a hydraulic pressure test of 120*.

All the parts except the pressure gauge were made from scrap given to Mr Cauley by friends. He bought the pressure gauge for thirty shillings.

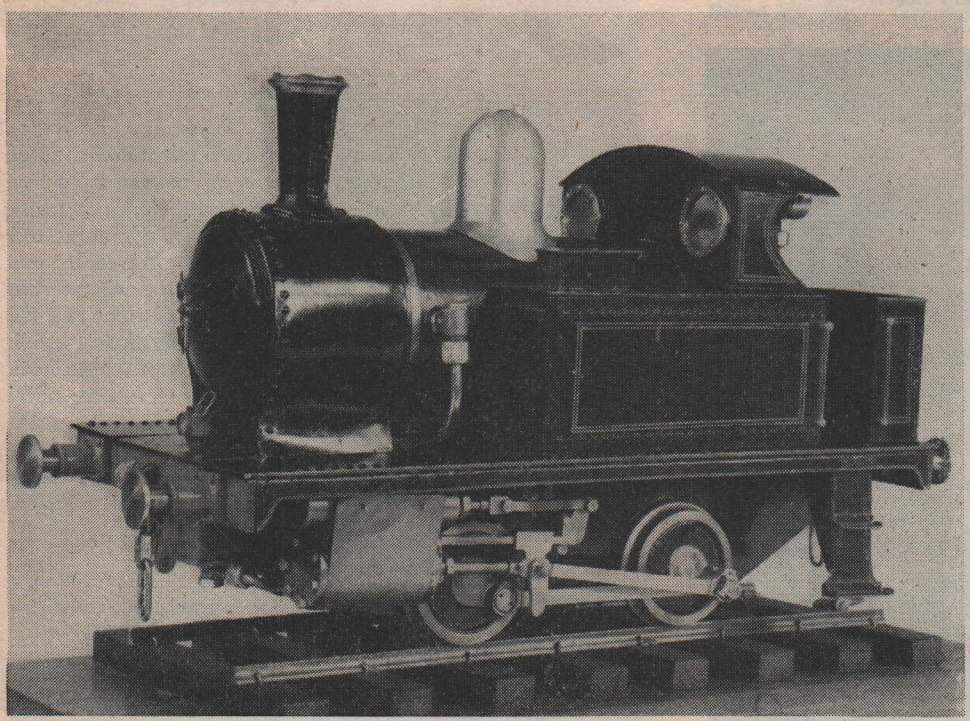
Mr Cauley is a regular reader of MODEL ENGINEER. He does not belong to any modelling society. When *Little Tich* has been completed, he will model a steam traction engine.

The late Ted Wilcox, who won the Duke of Edinburgh's trophy at the ME Exhibition, was also a member of ICI Alkali Division.

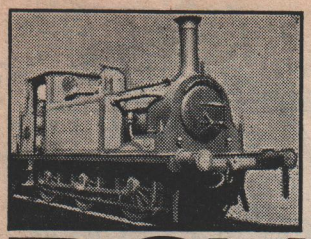
CLIFFORD HOUGH.

*MODEL ENGINEER *recommends hydraulic testing to double the working steam pressure.*—EDITOR.

Little Tich wins three prizes for young Peter



This LBSC engine, made by an apprentice as his first model, led all the entries in an ICI staff exhibition



BOXHILL

A 5 in. gauge model of the famous Brighton Terrier

Continued from February 1

By Martin Evans

This boiler contains several new features

THE boilers fitted to the *Terriers* were of quite simple design, and were not, of course, provided with superheaters. The modern fire-tube superheater did not come into use until early in the twentieth century. Its adoption revolutionised locomotive performance, and brought economies in water and steam consumption—sometimes up to 30 per cent.

Model engineers continue to debate whether the fitting of superheaters in model boilers is really worth while. The real difficulty is that no one so far has carried out accurate tests to establish either the exact temperatures reached in model superheaters and steam chests or the economies made in coal and water consumption. In the meantime, designers must rely on experience and observation.

My own view is that superheating in model locomotives justifies the small extra trouble involved. It is sometimes forgotten that even if the superheater temperature actually attained in the steam chest is low it will at least prevent any possibility of condensation—that arch-enemy of good cylinder performance. Admittedly the elements tend to block the superheater flues, making them difficult to keep clean. But this is not an insoluble problem. Where only two elements are used to each flue, it is generally possible to get a flue-brush down each side. The great thing is to remember to clean out all the tubes thoroughly after each run; if the sooty deposit is left, it becomes harder to remove after each steaming. Blast pipes which have to stand high up in the smokebox, as in the *Terriers,* prevent easy access for the flue-brush, and you will therefore do well to design the blast pipe so that it can be quickly removed and replaced without loss of alignment.

Although the boiler for the *Terrier* might be described as a typical narrow-firebox design, the barrel being very small in diameter, it is possible to make the width over the firebox equal to the diameter of the barrel. To fit the upper two rows of side stays—always a bit of a tussle in narrow fireboxes—is then much easier.

Readers unaccustomed to boiler work have told me that they have found the fitting of the longitudinal stays, with the usual internal and external threaded nipples at each end, rather a problem. If the threads on the two diameters are made to normal dimensions, it often proves quite difficult to screw the nipple home, owing to slight mis-alignment between the pitches of the threads. I have therefore considered the possibility of reducing the number of the longitudinal stays. The drawings of traction engine boilers which have appeared in ME recently gave me the idea which you can see in my drawings: a curved plate stay brazed to the inside of the backplate and the smokebox tubeplate—rendering these plates self-supporting.

Let me now utter a warning. Longitudinal stays can be dispensed with only where there is no break between the barrel and the outer firebox wrapper. To eliminate the stays in a boiler with a separate barrel would be courting disaster ! In making the *Terrier* boiler we construct the firebox wrapper by using the seamless tube which forms the barrel. As the wrapper made in this way is not quite deep enough for our purpose, it is extended in the usual fashion with a strap on the inside.

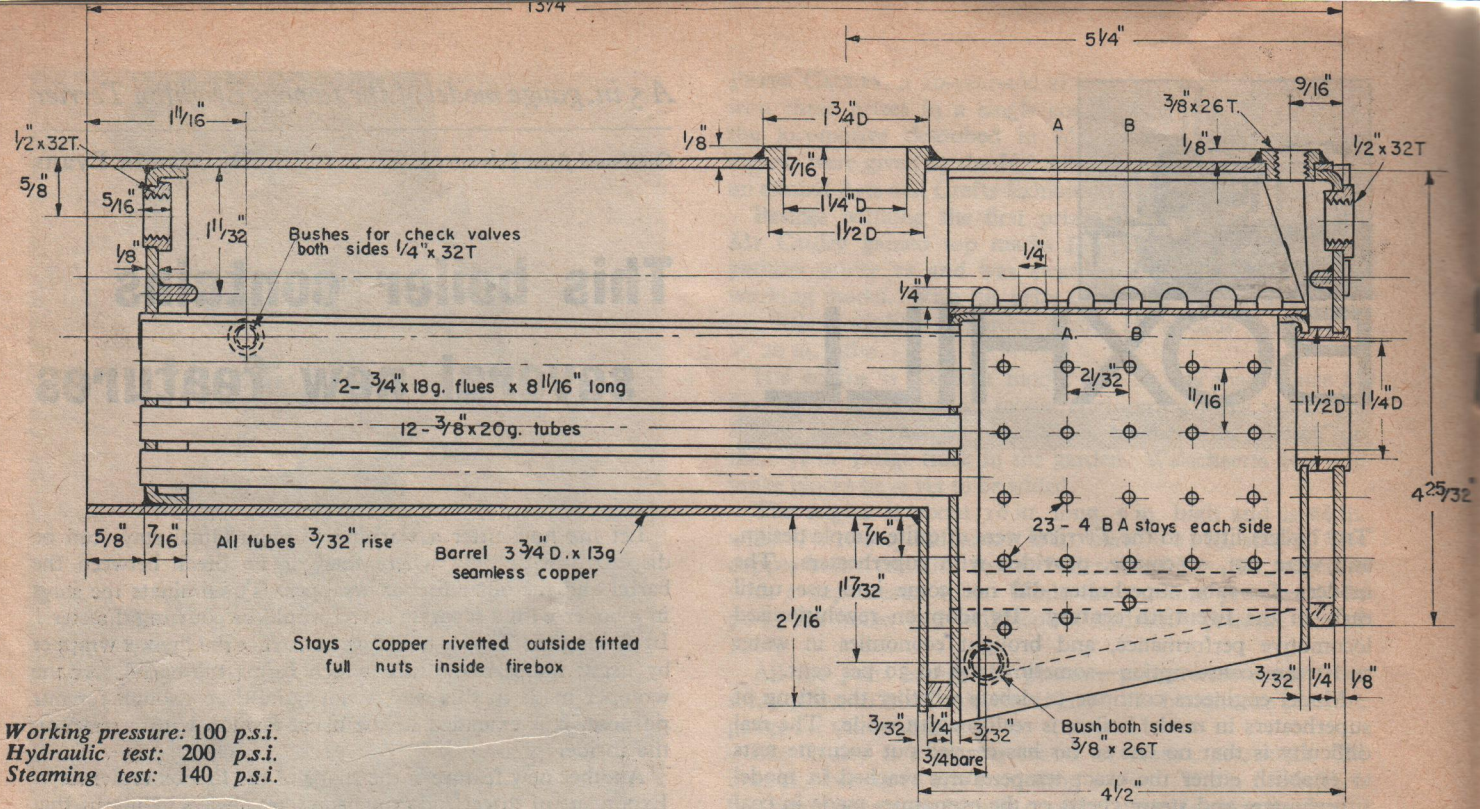
Another new feature is the shape of the firebox crownstays. Exponents of direct rod crownstays are always telling us that they are much superior to the conventional girder crownstays found in almost all model locomotive boilers, especially on the score of better water circulation. The crown of a firebox is, of course, the part of the boiler which has the highest steam raising value; it follows that good water circulation here is highly important.

Rod stays are very difficult to fit to round-top fireboxes, and with an inner wrapper only $\frac{1}{16}$ in. thick there would not be many threads actually in the plate. It occurred to me that we could use the normal girder crown stays and cut away the lower part of them to give a sort of viaduct appearance, so that water could flow right over the firebox with little hindrance.

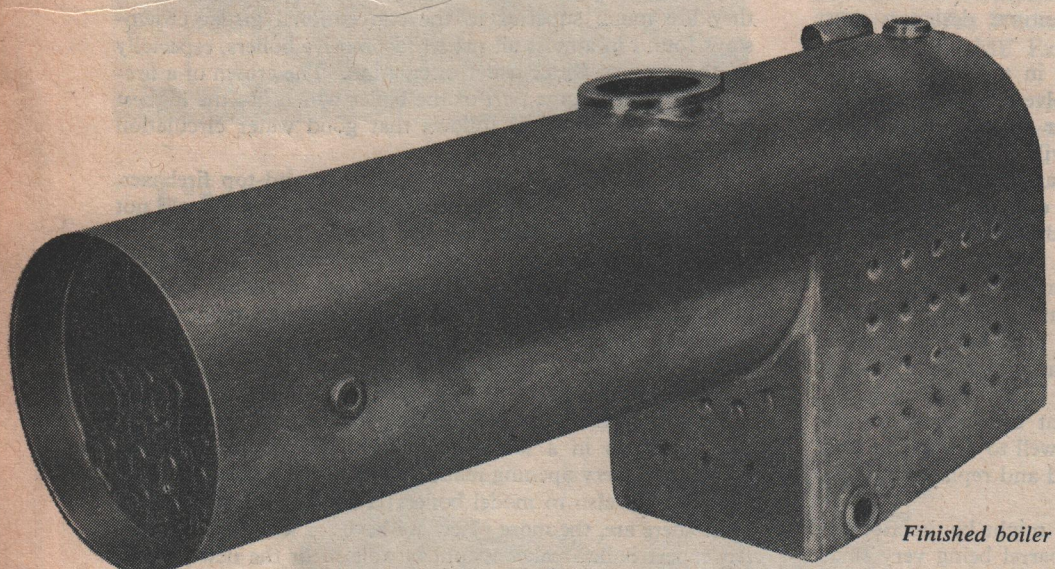
Drummond's views

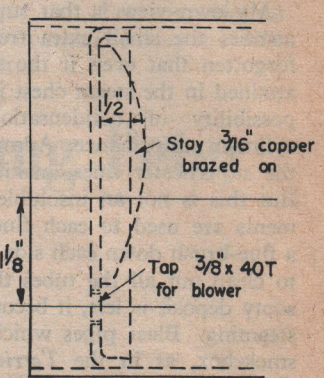
Dugald Drummond, like Stroudley himself, used to say that openings in a locomotive boiler should be as few as possible, as every opening made weakened the whole structure. This applies also to model boilers; I may add that the more holes there are, the more places we have for leaks to develop ! An expert boiler-maker would be able to fit the new type of crown stays to his boiler with not more than four rivets, relying on the silver-soldering to hold the parts together. The beginner should use about eight, one to each corner top and bottom. If the other feet of the crown stays do not bed down properly on the sheet, leaving a gap of, say, two or three thou between, this will not matter in the least, as any brand of silver solder will fill such a gap without trouble.

Other features of our *Terrier* boiler are blow-downs at the lower front corners of the firebox which can be operated with ease while the engine is in steam on the track, and firetubes which are arranged with a slight upward slope towards the smokebox tubeplate (this is also a feature of the full-size boiler) which makes tube-sweeping easier as well as slightly improving the draught. You may think that a larger number of tubes could have been put in, but in my view it does not pay to crowd in too many. While a larger number may increase the theoretical heating surface, it will



Working pressure: 100 *p.s.i.*
Hydraulic test: 200 *p.s.i.*
Steaming test: 140 *p.s.i.*





Finished boiler for BOXHILL

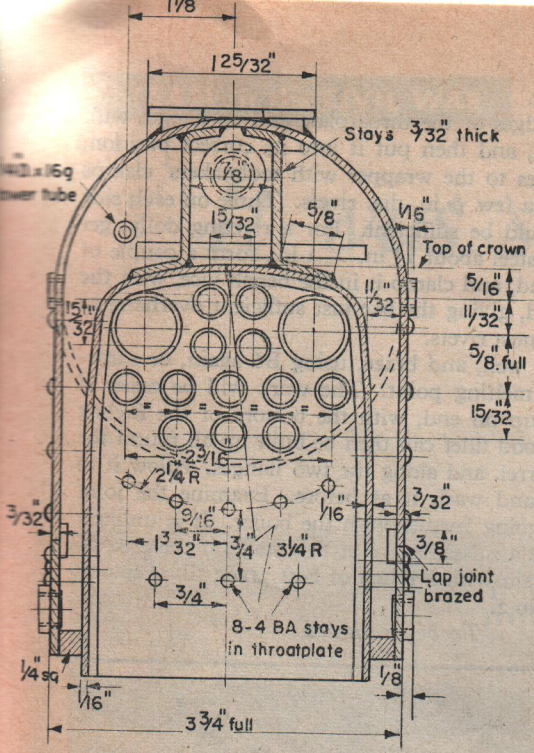
seriously affect the circulation of the water around them. Good circulation is as important as plenty of heating surface.

I hope that newcomers to boiler work will not be frightened by the innovations which I have incorporated. As can be seen from my pictures, the boiler has been built and thoroughly tested. The work was entrusted to Mr Farmer of Birmingham, as I did not have time enough, and he has built the boiler exactly to my drawings. It has been tried to well over twice the designed working pressure, a test which it passed with flying colours. Steam is raised very quickly, and anyone who builds his boiler in the same way will be entirely satisfied with its steaming capacity. It is also quite an easy boiler to make.

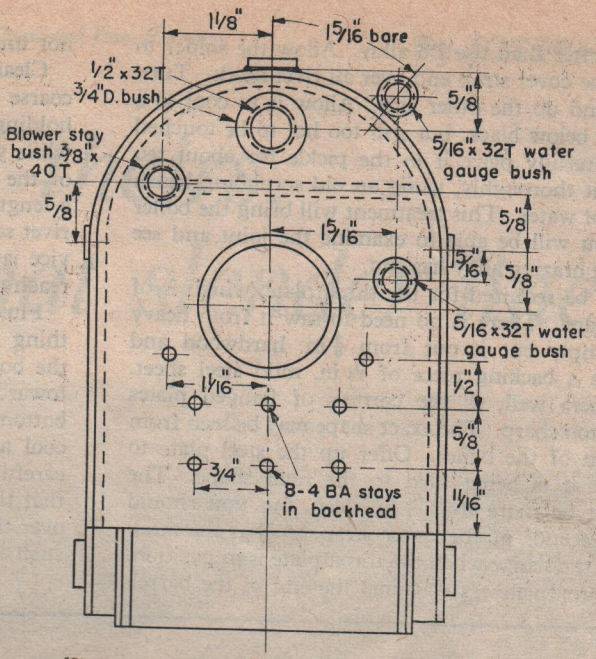
There is little doubt that the proper oxy-acetylene outfit, in skilled hands, is best for the brazing. The next best is probably a good air-gas blowpipe; one of 1 in. nominal diameter would make short work of a comparatively small boiler like the *Terrier's*. A ¾ in. air-gas blowpipe would also do the job all right, though rather more care would have to be taken in packing coke around, especially towards the end of the work. One of the larger Propane blowpipes could be used; and last but not least (as far as the total heat is concerned), there is our old friend, or enemy, the five-pint paraffin blowlamp !

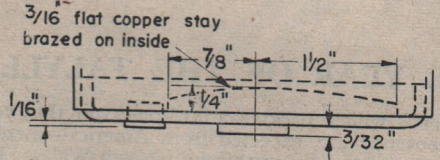
I still receive many queries about the type of acid needed for pickling boilers after brazing. The best procedure is to order from the local chemist some commercial-grade concentrated sulphuric acid, and dilute it in the ratio of 1 part acid to 100 parts water. This is quite strong enough. Do not forget that the acid must always be added to the water—*never the water to the acid.*

Cut off a suitable length of seamless copper tube 3¾ in.

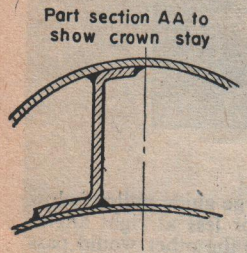


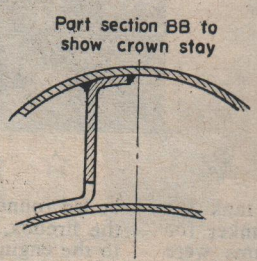
SECTION LOOKING FORWARD



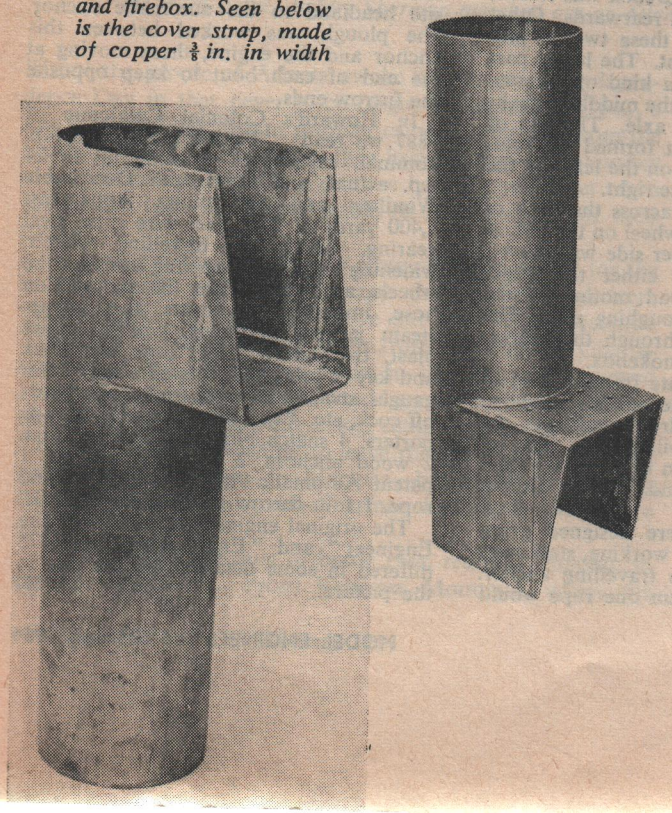


BACKHEAD DETAILS





Wrapper for the boiler and firebox. Seen below is the cover strap, made of copper ⅜ in. in width



o.d. × 13 s.w.g. (3/32 in.) and square the ends in the lathe. Saw out a couple of hardwood discs about ½ in. thick, fit a steel bolt about ¼ in. dia. with a centre in it to one of the discs, and turn them until they can be pressed into the barrel without the need of too much force. Arrange the disc with the centre at the outer end, so that the tailstock can support the barrel. The other disc prevents the chuck from distorting the tube. The ends are now faced in the usual way.

Saw into the underside of the barrel at a point 4 7/16 in. from the rear end, finishing the cut ⅛ in. below the boiler centre-line on each side. Then saw up the middle of the tube, starting at the rear end, to meet the first cut.

Anneal the barrel by heating it uniformly to a dull red colour and plunging it into clean cold water. You can then open out the lower part of the tube to the shape required for the outer firebox wrapper. Re-anneal if the metal shows any signs of going hard before the desired shape has been produced.

As you must extend the wrapper downwards, so as to obtain the proper depth of firebox, cut out two pieces of 3/32 in. copper sheet to the shape and size required, and rivet them on by putting a cover strap of the same material on the inside. The cover strap must be a full ⅜ in. wide, but must not be the full length of the wrapper itself as clearance is required for the flanges of the throatplate and backhead. Six 1/16 in. dia. copper rivets on each side of the boiler should be enough, the rivets being countersunk on both sides of the plate for neatness.

Place the rear end of the boiler in the pickle for about ten minutes, to make quite sure that it is clean. Wash it in running water and dry it. Then lay the boiler in the brazing hearth on one side after carefully treating the joints with the appropriate soldering flux. With a blowlamp or air-gas

you cannot do better than use B6 alloy. Allow the solder to run freely over the cover strap and over all rivet heads. Turn the boiler over and do the other side. Allow it to cool to a temperature well below black, but still too hot to be touched by hand, and carefully place it in the pickle for about ten minutes. Wash it thoroughly, using an old scrubbing brush with Vim and hot water. This treatment will bring the boiler up clean and you will be able to examine the joint and see exactly where the brazing alloy has run.

A former will be required for the throatplate, which is of a very simple shape. There is no need to saw it from heavy gauge steel. Simply cut it out from $\frac{3}{8}$ in. hardwood and screw on to this a backing piece of $\frac{1}{16}$ in. mild steel sheet. Round the corners well, as the corners of flanged plates should never be too sharp. The exact shape may be seen from the end elevation of the boiler. Offer up the steel plate to the barrel while it is being filed to the final shape. The flanges need not be more than $\frac{1}{4}$ in. deep, but you should check against the ends of the cover strap, so that the strap butts up against the flange when the throatplate is in position. Note that the throatplate rests against the end of the barrel, not underneath it.

Clean up the edges of the throatplate and its flanges with coarse emerycloth, and then put it into its correct position, holding the flanges to the wrapper with toolmakers' clamps while you put in a few $\frac{1}{16}$ in. dia. rivets. Three on each side of the boiler should be sufficient. For a riveting dolly, get a length of mild steel about $1\frac{1}{2}$ in. $\times$ 1 in., form a couple of rivet sets in its end, and clamp it in the bench vice, with the vice jaws removed, giving the bar just sufficient overhang to reach the furthermost rivets.

Flux this joint well, and braze, using B6 again, or something of similar melting point. The work will be easier if the boiler is set up on end, with the bottom of the firebox towards you; a good fillet can then be built up all round the bottom of the barrel, and along the two flanges. Allow it to cool and pickle and wash it as before. Examine the joint carefully before going further with the boiler. It is unlikely that there will be a missed place at this stage, if there is, go over the work again with a touch of best grade silver solder, such as Easyflo No 2.

To be continued

ANOTHER YEAR OF THE TALYLLYN

AMONG the crowds which pack Stratford-on-Avon this year—hundreds of thousands are expected from America—there will be many who will make their way up into North Wales. There they will discover, among the natural attractions of that wild and lovely countryside, the Talyllyn Railway.

The company which owns the line can expect a record sale for its 1964 calendar, now on sale in an improved form. Here is one of the pictures.

☆ ☆ ☆ ☆ ☆

Farmer's Friend

Among those who were surprised to read of the Howard ploughing engine preserved in the United States was R. C. Stebbing, rector of Tacolneston in Norfolk. He writes here from his unsurpassed knowledge of steam in the fields

V. E. CHALKLEY'S fine picture of the Howard ploughing engine at Greenfield Village must have been a surprise to many; it was generally believed that a similar engine which J. & F. Howard had preserved at their Britannia Works, Bedford, and cut up after the disastrous failure of the AGE combine in the early 1930s, was the last of the race.

Under the name of " Farmer's Engine " or " Farmer's Friend " this type of engine first appeared at the Taunton RASE show in 1875. It was an 8 h.p. machine with a cylinder 9 in. $\times$ 12 in. and a boiler 3 ft dia. and 5 ft 6 in. between tube plates. The grate area was 5.375 sq. ft. To a heating surface of 162.5 sq. ft, the firebox contributed 29.5 and the 41 $2\frac{1}{4}$ in. tubes, 133. There was room in the tank for 230 gallons and in the coal bunker for 15 cwt. The two winding drums were 3 ft 8 in. dia. and the hind wheels 5 ft 6 in. $\times$ 16 in. The overall width was 7 ft 9 in.

To each side of the firebox was riveted a plate which extended rearwards. Other plates were bolted to these two to provide a tank arrangement. The lower part stored the water, and a kind of inverted trough passed through the middle to make a tunnel for the hind axle. The top of the water compartment formed the footplate, with the bunker on the left and the horizontal engine on the right.

The crankshaft ran across the back of the engine with the flywheel on the left. A spur pinion on the other side was moved axially to mesh with either the larger spur wheel of the road motion or the smaller part of the ploughing gear. The exhaust pipe passed through the ashpan to the bottom of the smokebox.

Two drums in a plate frame bolted to the tank formed the detachable windlass. At each end of the drum shaft was the cam wheel of the coiling gear, the reverted epicyclic pattern invented by John Fowler. One cam and coiling arm is visible in the picture.

These machines were designed primarily for single engine working, stationary or moving opposite a travelling anchor. With the second system one rope would be led round the large guide pulley below the firebox, more or less at right angles to the engine, while the other would pass between smaller guides below the front axle, along the headland, and round snatch blocks anchored along the opposite headland to the automatic anchor. The plough was worked between this anchor and the engine, these moving at the end of each bout to keep opposite the furrow ends.

In Howard's Colonial Catalogue of 1887 we read: " Farmer's Friend 8 h.p. nominal, capable of working up to 24 h.p. actual, and fitted with Detachable Windlass and Self-coiling Apparatus; 1,400 yards of 2 in. steel wire rope, steel gearing, brakes to travelling wheels, widening rings and grappling irons for the wheels, automatic water lift and suction hose, improved governors, feed pump, steam jacketed cylinder, whistle, steam blast, two safety valves (one with lock and key if preferred), pressure and water gauges, steam and water trial cocks, blow-off cock, etc. Equipment includes 10 rope porters, 4 snatch blocks, 6 claw anchors, 2 wood anchors, 2 anchor couplings, 1 patent Automatic Anchor with headland rope, 1 four-furrow plough. FOB £800."

The original engine illustrated in " The Engineer " and " Engineering " in 1875 differed in some details from the one in the picture. ▣

Continued from February 1

By JOSEPH MARTIN

"It was still theirs, that slender line"

Empty roundhouse in Atlanta. The railroad yard appears to be on the big curve where the tracks left the city for West Point. Before Sherman marched out of Atlanta all these buildings were in ruins. (US National Archives)

WHEN the people of Atlanta awoke on the eve of Independence Day in that never-to-be-forgotten summer of 1864, a low rumbling like distant thunder came to their ears from the north. Later in the morning they heard it above the Sunday message from the spires. The time had not yet come when the church bells of Atlanta would be melted down for their metal.

So far the roads into the city remained open except for the invasion route itself, the Western and Atlantic line from Chattanooga. Trains could move out for a short distance. There was nothing to stop them from crossing the Chattahoochee River, near whose banks in 1833 a pioneer named Hardy Ivy, deciding that he would go no farther south, had reined his horse and built a log cabin among the friendly Cherokee. Anyone wishing to leave the city in that direction could travel by train to Marietta—but there his journey ended. William Tecumseh Sherman had made Marietta a terminus.

To the north the dust of battle rose, red and choking, in the hot bright air. From Kenesaw Mountain, where the Federal losses had reached three thousand, the fury of war was drawing ever closer to the Gate City of the South; and now, on this first Sunday of July, the thunder of guns made it doubtful whether the trains would be much longer able to run even the eighteen miles to Marietta.

After failing to break Johnston's line in the furious assault at Kenesaw, Sherman had considered moving his whole army down to Fulton, or to the Chattahoochee itself. Military geniuses largely owe their greatness to a capacity for making moves which seem extraordinarily simple, and frequently obvious, to most people but not to other strategists. Commenting on a later and similar manoeuvre by Sherman, Captain B. H. Liddell Hart says that he had "come to realise, as few commanders or military doctrines have done, that if your opponent can be sure as to your objective he has the best possible chance of guarding himself and thwarting your aims—whereas if you operate on a line which offers, and threatens, alternative objectives you create distraction in the opponent's mind and forces, thus producing both dispersion and paralysis." An ordinary person would assume that the

whole act of strategy consisted in fooling your enemy or leaving him uncertain; but here an eminent authority tells us, in effect, that Sherman was being revolutionary in refusing to do exactly what the enemy expected.

In the campaign before Atlanta the Confederate generals expected a continuing assault. It was more or less laid down, as in the rules of a game, that when your enemy drew near you marched up and fought him, even if you were at a clear disadvantage. But Sherman did not hold to rules. With an audacity that was to upset the military academies of the world, he moved right off, leaving the enemy nonplussed. What was the point of fighting one Gettysburg after another, as it were, when the material and moral strength of the South could be vastly weakened by the destruction of factories, stores, communications and everything else that was vital to the continuance of hostilities ?

" In his advance to Atlanta," writes Liddell Hart in his introduction to Uncle Billy's own account of the campaign (*From Atlanta to the Sea,* Folio Society, London), " Sherman's manoeuvre was all the more notable because, by contrast to Grant in Virginia, he was tied to one line of railway for his supplies. Yet, rather than commit his troops to a direct attack on an opponent well-placed to block him, he cut loose even from this supply line. In all these weeks of

One of the many maps in From Atlanta to the Sea, *by W. T. Sherman, published in Britain by the Folio Society*

manoeuvre, he only once delivered a frontal assault, at Kenesaw Mountain, and that was in the hope of saving his troops from the strain of a further flank march over rain-swamped roads. When it was repulsed, the attack was stopped immediately after the first check."

As July opened, Sherman gave orders that the railroad should be stripped as far as Allatoona, which would be used as a depot, with a strong cover of cavalry. While General Thomas thought it risky to leave the railroad, Sherman insisted that " something had to be done." He decided to bring his right flank within three miles of the Chattahoochee and about five miles from the W & A route. " By this movement I think I can force Johnston to move his whole army down from Kenesaw to defend his railroad and the Chattahoochee, when I will (by the left flank) reach the railroad below Marietta; but in this I must cut loose from the railroad with ten days' supplies in wagons . . . The move is

Loaded with refugees—the last train from Atlanta

substantially straight down the Sandtown road straight for Atlanta."

On July 5 the *Daily Intelligencer* reported from near Ruff's Station that the Confederate army had begun to withdraw from Marietta. " The movements of both armies indicate that Sherman must now fight for the possession of the city, or that, declining a battle, he will continue his flanking operations with the hope of possessing the railroads leading to this point, eventually surrounding and besieging it."

That afternoon Sherman himself arrived at Vining's Station on the other side of the river from the city. Walking to the top of a steep hill, he looked across at the roofs and spires nine miles away. Atlanta was in tumult. Army wagons rolled unceasingly through the graceful streets, and train after train brought in the wounded, to be met by girls like Scarlett O'Hara in *Gone With the Wind.* No one knew what would happen. Citizens hid their valuables, digging pits in the garden or flaking away the ceiling plaster in corners where a hole might not be noticed. Others packed their most necessary and precious belongings, preparing to leave, hoping for a train.

The railways had made Atlanta. It was full, as Sherman said, of factories, arsenals and machine shops. Beside the railroad line on the east it had the Lewis Schofield rolling mills, an invaluable source of armour plate for the Confederate ironclads. For all its grace, all its pride in the aristocratic tradition of the South, it showed a Northern vigour in the pursuit of industry. And all this use of machines derived from one of them—the steam engine which had transformed America and would transform it even more.

If Atlanta had grown within less than thirty years from Ivy Hardy's log cabin to a flourishing city of about eleven thousand people, it could thank the ghosts of Richard Trevithick and George Stephenson. More directly it owed an immeasurable debt to the American railroad pioneers who, at the very beginning of the Railway Age, had imagined the trains rolling through Georgia and had made that vision a reality.

As early as 1836 Georgia had planned a State line with its terminus at a little place near the Chattahoochee. A train shed was erected and a house for an engine-driver, and in 1843 the settlement had grown into a town which had been named Marthasville after the daughter of Governor Lumpkin. Four years later it became Atlanta.

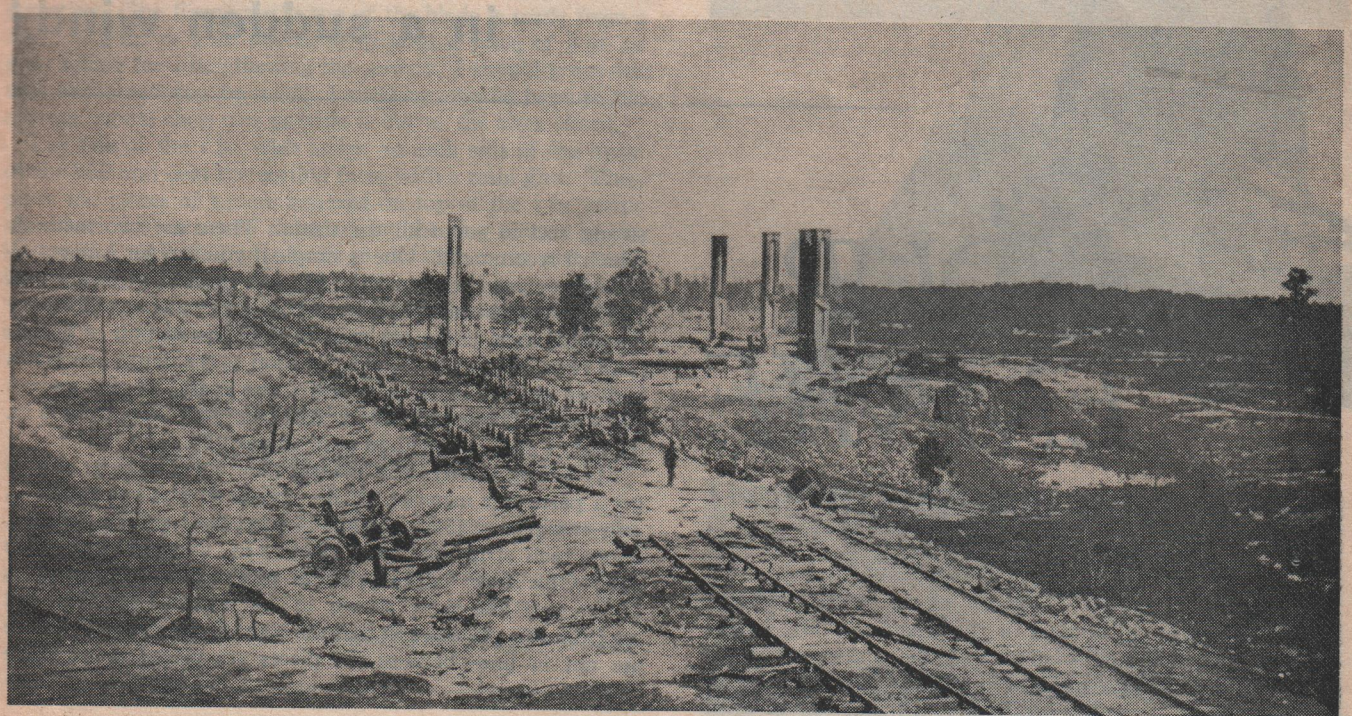
Even the name—a lovely name, with all respect to Martha Lumpkin—derived from the railroad, from the Western and Atlantic, for control of which Americans were now killing one another. After having prospered as a terminus, it thrived still more as a junction.

Some railways in the United States were given ambitious names which they fell short—sometimes by a thousand miles or so—of ever fulfilling. But the line north of the Gate City had a solid claim to be known as the Western and Atlantic.

After constructing a line 137 miles west from Harrisburg in Pennsylvania to Hollidaysburg, John Edgar Thompson had gone to Georgia and connected Atlanta (for only 17,000 dollars a mile, compared with 54,000 dollars for the Baltimore and Ohio) with Augusta. The traveller wishing to go farther east could then use the South Carolina; its 186 miles had linked Hamburg, a little east of Augusta, with the Atlantic port of Charleston as early as 1833, only four years after the *Rocket* performed at Rainhill.

The other route to the Atlantic was similarly provided by two railroads, a line running down from Atlanta to Macon, and the Central Railroad of Georgia which carried on from Macon to Savannah.

Horatio Allen, the engineer who persuaded the South Carolina and Rail-Road Company to use steam power—it was he who bought the *America* and the *Stourbridge Lion* in England—emphasised his faith in steam by saying: "There is no reason to expect any material improvement in the breed of horses in the future, while, in my judgement, the man is not living who knows what the breed of locomotives is to place at command." Of all the people in America a hundred years ago, none would have given stronger assent to those words than the citizens of Atlanta. For them the present and the future depended on tracks and locomotives; even more than Sherman, they saw the war in terms of railroads.



All that remained of Schofield and Markham's great rolling mill beside the railway—maker of armour plate for the Confederate ironclads. The destruction was caused by the Confederate troops when they blew up several ammunition trains (see the story of the General*) on the first morning of September a hundred years ago. This picture and the one of the ruined railroad depot are by courtesy of the Library of Congress in Washington*

As the city itself was a symbol to the Confederacy, so the railways—the very rails themselves—had become a symbol to the soldiers who fought beside them and the civilians who tried hard not to believe the worst. So long as the railroad was not lost, hope remained. Margaret Mitchell wrote with moving truthfulness of those days before the end: "It was still theirs, that slender line winding through the sunny valley toward Atlanta. Men lay down to sleep where they could see the rails gleaming faintly in the starlight. Men lay down to die, and the last sight that met their puzzled eyes was the rails shining in the sun, heat shimmering along them."

And now the Western and Atlantic was theirs no longer. On the evening of July 9 the people in the city saw a red glare to the north. Falling back despite every effort, the Confederate defenders had burnt the railroad bridge over the Chattahoochee.

William Tecumseh Sherman was at the gates of Atlanta.

To be continued

Oliver Smith, who is building this Thames sailing barge on BBC television, describes the construction of the centre-board keel

No crew to shorten sail in a sudden wind!

OUR EMMIE

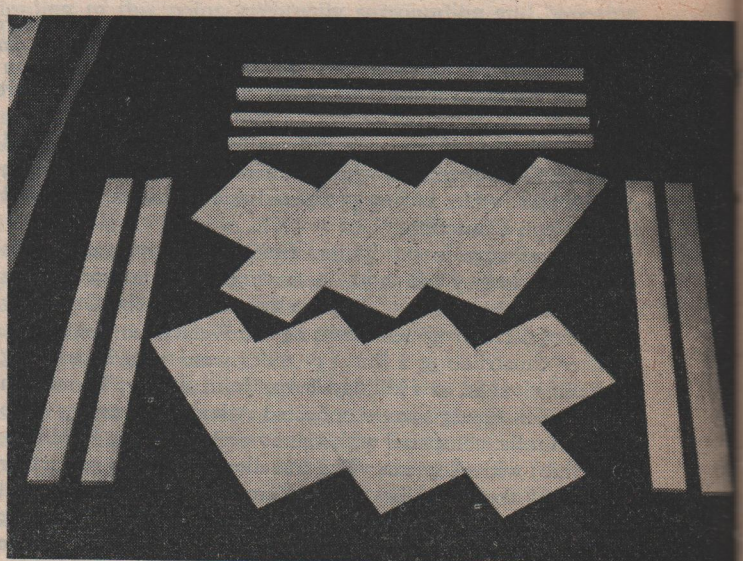
Continued from February 1

AMONG the many advantages of the Thames sailing barges was their shallow draught—so much so that a skipper boasted that he could sail in a meadow provided it was covered in a heavy dew! Certainly *Our Emmie* will not sail in open water unless we fit a centre keel board and weight. While we can scale the size and shape of a ship model we cannot scale the conditions in which it will sail. Nature is not so obliging as to supply two kinds of weather in the same area at the same time. A light wind that will produce a ripple alongside the hull of a full-size vessel may be enough to swamp a small model on a pond. We must remember, too, that once the model is launched from the pondside it is virtually on its own. *Our Emmie* carries no crew to shorten sail if the wind suddenly rises when she is half-way across the water.

By fitting a centre-board keel, and weighting it at the bottom to lower the centre of gravity, we are able to overcome this capsizing problem without great difficulty. I have designed the keel for *Our Emmie* so that it can be easily detached when it is not in use. This enables her young owner to display her in his room without having to make a special stand; he may also find her easier to carry. These features are purely optional and can be modified to suit personal preferences.

An essential requirement of the centre-board of the keel is that it remains rigid and is not too thick and clumsy. I found that the ideal thickness was $\frac{1}{4}$ in.: it gave me a very strong keel to stand all the strain. There are two methods which I recommend. One is simple if you can get $\frac{1}{4}$ in. resin-bonded or marine plywood. All you need is a piece 14 in. $\times$ 5 in. cut to the shape shown in the drawing. Ordinary plywood, such as the ply used in the construction of household furniture is not suitable; as soon as the damp penetrates between the laminations it will come apart. If you cannot get a resin-bonded plywood, fabricate your keel from $\frac{1}{8}$ in. obeche. I used this method quite sucessfully.

My young viewers and readers may not always be able to get a particular material. If the obeche strip is cut carefully, only two pieces, 36 in. $\times$ 3 in. $\times$ $\frac{1}{8}$ in., need to be purchased. From each strip cut three pieces 8 in. long and one piece 4 in. Glue them edgewise so as to produce the two sides of the keel like those shown in the illustration. You will see from this photograph that the ends of the pieces of obeche are not in line—because the pieces are placed at an angle



Parts for the laminated centre-board keel

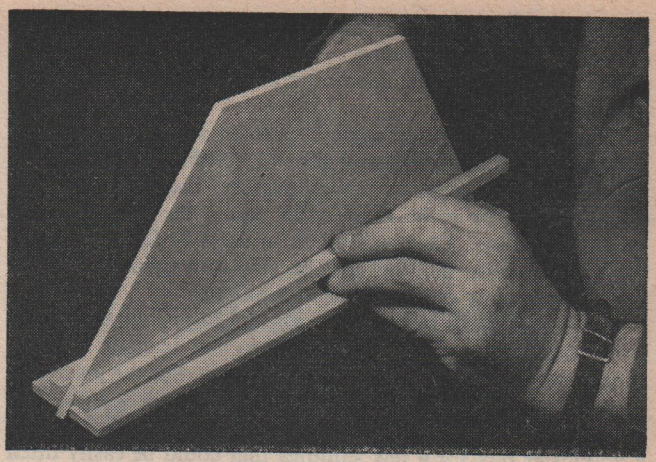
of about 55 degrees when they are first glued together. When the glue has set, the two halves are joined face to face with the strips in one piece lying at the opposite angle to the mating piece. In this way maximum strength will result from the lamination.

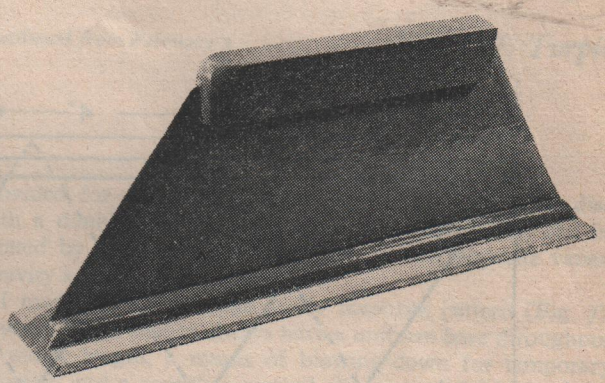
Whichever means is preferred to make the centre-board, the first part of its shaping is the cutting to size. This presents no difficulty. Measure off 14 in. along the top edge, and then half way along this dimension draw a line at right angles down to the bottom edge. Mark off 3½ in. each side of the centre line, and join up with a line to the top corners. Cut along this line with a tenon saw and clean up the edge with a piece of glasspaper. You now have the main part of your keel.

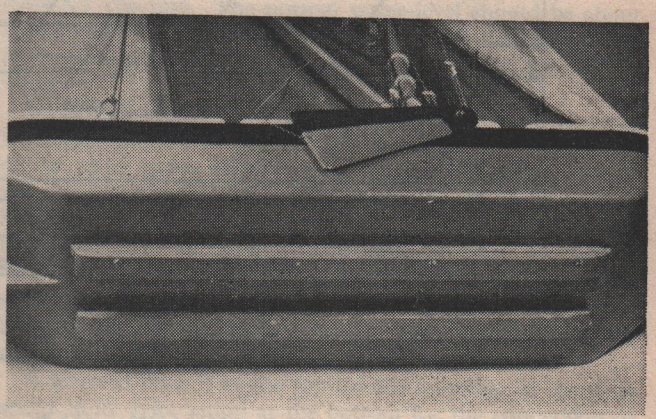
As I said earlier, I made my keel removable. If you prefer yours to be a fixture you can use the same method of construction. The flange at the top of the blade is made from a 1 in. × ⅜ in. or ¼ in. obeche strip with a piece of ⅜ in. or ¼ in. square for strengthening the corners. I should point out that any wood can be used: I mention obeche because the average model shop can provide it cut to the sizes stated.

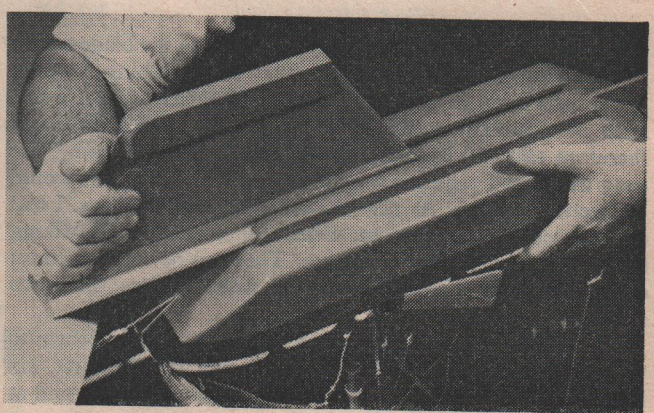
Lay one of the 1 in. wide strips on each side of the blade of the keel and coat the mating faces with a resin glue. Then place the pieces of square material on top of the 1 in. strips close into the corner to the blade in the way shown in the illustration. All that you have to do then is to give time for the glue to set.

To make your keel a fixture to the hull, screw the flange section to the underside as soon as the pieces have stuck. If you prefer to adopt my own system, carry on and prepare the slides or runners while you are waiting for the glue to dry.









Top: Assembling the top flange of the keel board

Next to top: Keel with 2 lb. ballast weight

Right: Slides on the underside of the hull

Below, right: Sliding the finished keel into place

Whatever size of material you used for the flange you will now need again in the same number of pieces. This time the 1 in. strip is fitted on top of the square piece and the two are fixed to the hull by four 1 in. × 6 brass wood screws. You will find it an advantage to mark out the position of the slides on the underside of the hull before fitting them. As the keel must be fitted centrally and parallel with the sides, draw a centre line down the length of the hull and continue it under the stern section. You will find this part of the line a help when the deadwood is added. Then each side of the centre line on the underside of the hull, draw two more lines, at 1⅜ in. centres if you used ¼ in. square wood, and at 1½ in. if you used ⅜ in. square.

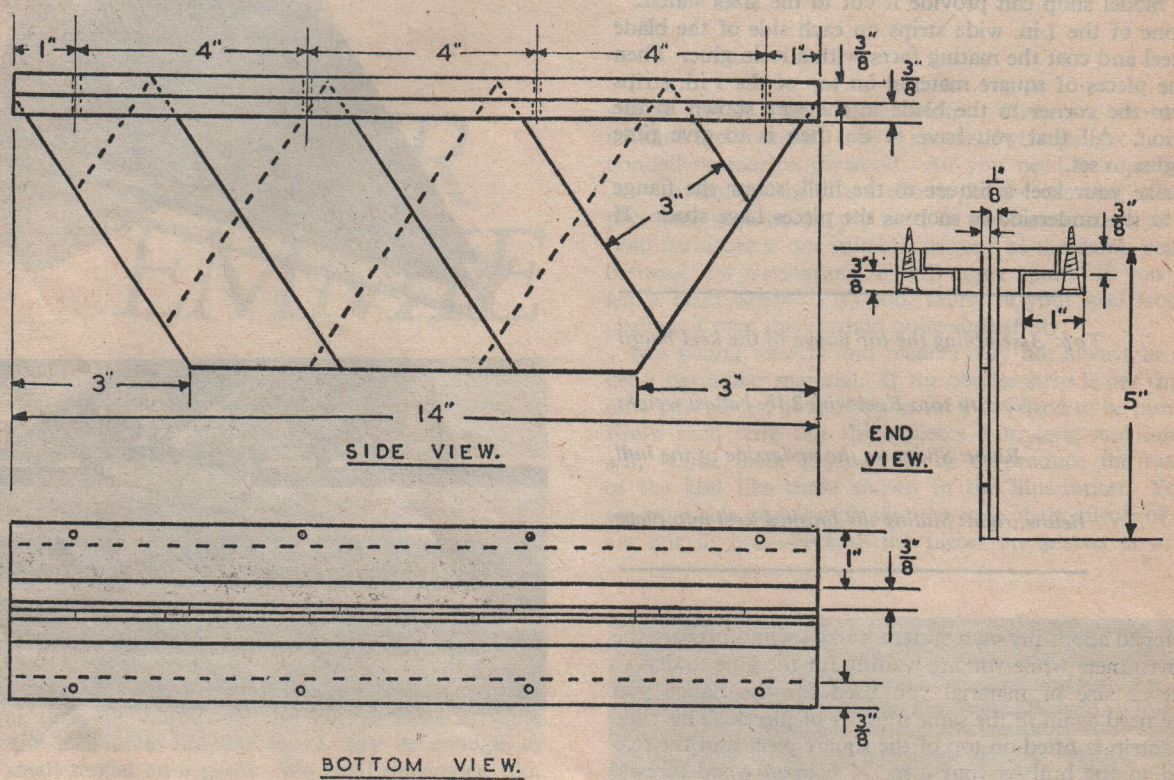
Take a piece of your square section, clamp it level with one side of the 1 in. strip, and drill four 9/64 in. or ⅛ in. holes for the wood screws. Make the two end holes at 1 in. in and the remaining two at 4 in. centres. Countersink the holes in the piece of 1 in. wide material so that the heads of the screws will sit flat with the surface of the wood. Fix the first half of the slide by fitting it to the line already marked,

but before you add the second half lay the keel in position and check for discrepancies. Any necessary adjustment can then be made before the remaining half of the slide is screwed down.

The keel should be a smooth push-fit so that it will stay put without the need of any pins or screws. To adjust the slides place brown paper shims between the square section and the hull, or make a few rubs across the flange on the keel with a rasp. Do not hesitate to use a little lubricant. I used a little olive oil, and as it became impregnated into the wood it gradually produced the fit required.

As the keel on its own is not sufficient to prevent the model from capsizing, a weight is fixed to the bottom edge. I found out from the trials which I made that at least two pounds would be needed. But while I was solving one problem I was presenting myself with another. What could a youngster buy for a few shillings that could be easily fitted and produce the necessary weight? For me it was easy: I had only to screw some odd pieces of metal to the blade which I had lying in the workshop. The nearest thing I could get from a shop in the form of a metal ballast weight was a strip of plumbers metal made by Fry's. It was soft, and therefore easy to drill, and it weighed easily a pound. The snag was that I required two such pieces and the cost would be twelve shillings. As this was too much for the boys, I had another look at the problem. I then hit on the idea of making the weight from sand and cement. They can be bought almost anywhere ready-mixed in small packets for less than two shillings.

Work completed and in position



The problem of making up the weights and fixing them to the keel was not as difficult as you may think. First, six holes were drilled in the bottom section, three ½ in. up and at 3 in. centres from the centre line, and then another three 1¼ in. up from the bottom. Into these holes were inserted three 1¼ in. × 6 brass wood screws on each side of the keel alternating so that one screw was allocated to one hole. My idea was that the cement would be keyed by these screws and held in place against the blade.

Next, a mould box was made up from some odd pieces of wood (nothing elaborate is needed because the box is intended to be used only once) to produce a two-pound ballast weight of sand and cement. The mould was 2 in. wide and 2 in. deep, and the length was made so that the ends fitted against the keel when it was resting on the bottom of the mould.

Continued on page 144

HACKFLY

Model locomotive with a modern ejector

THE fitting of axial bushes on a sloping backhead involves an awkward-shaped flange to the bush. Fig. 5 shows a means of shaping the inner face of the flange by hand when the work is held in a simple jig—a piece of $\frac{3}{4}$ in. mild steel bar with a recess at one end to fit the flange diameter and a central screw to hold the bush in place. Afterwards the recessed end is chamfered off at 10 deg. and casehardened, and the bush is inserted in the recess and held by an axial screw with the head slightly smaller than the shank of the bush. We can use a $\frac{1}{4}$ in. dia. clamping screw with $\frac{3}{8}$ in. dia. head.

The bushes for the longitudinal stays are tapped 40 t.p.i. and those for the fittings are 32. For the stays we need fine threads as it is impracticable to make threads continuous at each end of the boiler. At each end of the stays there are four threads. The error in position of the thread at the moment of coupling is equal to the pitch of the thread, 0.025 in. Even with this error the threads can be made to engage. Once assembled (with a smear of gold size) they seldom have to be dismantled.

Fig. 6 shows the longitudinal stays. The two at the top are solid and the lower two hollow. While the ends of the first are sealed up permanently, the hollow ones all have provision for standard union joints. But only one of the stays is used—the one on the right for the blower. Here the union at the backhead is for a $\frac{5}{32}$ in. pipe and at the front end for a $\frac{1}{8}$ in. union. For protection $\frac{1}{4}$ in. hexagon screwed caps should be screwed over the threads of the unused stay.

Screw a stay fully into the front fitting. Insert it from the smokebox end and tighten it fully. Screw the rear fitting on to it, and continue to screw until the fitting enters the bush in the backhead. The front end of this fitting, turned to $\frac{5}{32}$ in. dia. to form a spigot, makes the entry quite easy. You may have to exert some pressure for the thread to engage. Make all the joints with gold size.

The firehole ring, circular, and $1\frac{1}{2}$ in. internal diameter, is closed by a flap door made from 20g steel. It has a bottom hinge pin $\frac{5}{32}$ in. dia. passing through two $\frac{3}{16}$ in. square lugs on the backhead. Six $\frac{1}{4}$ in. holes in the door are provided for ventilation, adjustable by an interrupted disc with a double-turn spring washer on its axis. This can be rotated by the two out-turned lugs on two opposite vanes. Gravity keeps the door closed.

My favourite pattern of WATER GAUGE

Continued from February 1

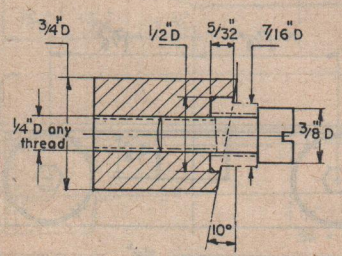
By H. J. Turpin

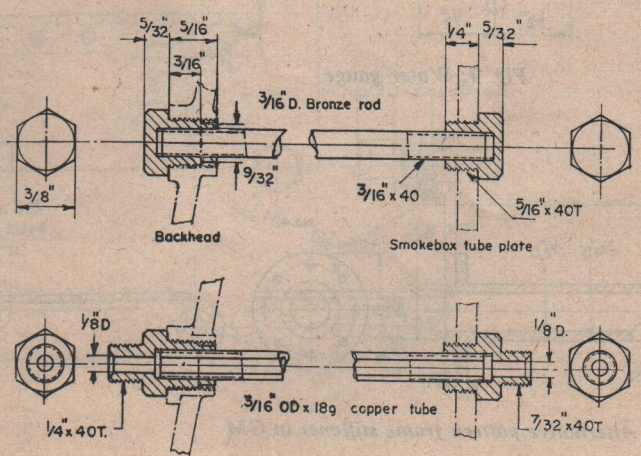
I made the water gauge to my favourite pattern (Fig. 7). A water gauge should always have a uniform bore throughout its entire length, a means of blowing-down for temporary clearing, and a complete vertical clearway of the bore of the glass for cleaning. The normal water-level should be about midway up the glass. When the water is at the bottom nut it should indicate a safe height of water over the firebox wrapper.

In this gauge the throughway diameter is $\frac{5}{32}$ in. and the minimum depth of water over the firebox is $\frac{1}{4}$ in. The design of the water gauge should be built around the glass tube—not the other way about. Get enough tube for half a dozen lengths, prepare them for assembly, and put them in the spare-part box. A suitable diameter is about $\frac{7}{32}$ in., with a bore close to $\frac{5}{32}$ in., and not more than that. Take a micrometer reading of the tube and make the bore of the top and bottom nuts only a few thou larger. This will give adequate support for the rubber glands.

A screwed plug is at the top for the assembly of the glass and a $\frac{5}{32}$ in. bore union at the bottom for the connection of

Right, Fig. 6: Stays—two solid and two hollow
Below, Fig. 5: Jig for hand forming inclined face of bush





the pressure-gauge pipe. The clearway thus formed is for the insertion of a $\frac{7}{32}$ in. steel rod with the lower $\frac{3}{4}$ in. turned down to $\frac{5}{32}$ in. dia. for the alignment of the two fittings to be checked before the glass tube is assembled. The two gland nuts should be assembled while this gauge is applied. The blow-down valve is provided as an extension to the lower fitting.

Fig. 2 illustrates the completed frame assembly and the way in which the boiler is mounted upon it. To attach the rear end of the frame, two bronze or gunmetal wings $\frac{3}{16}$ in. thick are set forward from the throatplate $2\frac{13}{16}$ in. apart (on the outside). They should be made with two rearward projecting spigots about $\frac{3}{16}$ in. dia. to fit the holes in the throatplate, and long enough to be riveted over lightly to it by a jig. Check the wings for position and squareness, and be sure that the centres of the holes are correct.

The side plates, which are $2\frac{13}{16}$ in. apart, should just slide over the wings. They are held by a 2 BA, $\frac{1}{4}$ in. hexagon-head screw each side. The front fixing is by two specially shaped screws with a $\frac{3}{16}$ in. stem which supports the boiler through the down-turned lugs of a bracket attached to the boiler barrel. The side plates are tapped $\frac{1}{4}$ in. $\times$ 32 to carry these screws.

Just above the two rear fixing screws for the frame is a $\frac{3}{8}$ in. dia. drag-rod, the reamed hole for which passes through the side plates and the two $\frac{3}{16}$ in. thick wings on the throatplate. To this rod are coupled the front ends of the footplate which accommodate the draghook. Thus the drawbar pull is taken directly from the frame by the drag-rod and footplate to the hook. No part of the boiler takes any of the load.

The side plates are connected to form the frame by the buffer beam at the front end, by the exhaust yoke (to be described later) and by two tubular stiffeners. The buffer beam, made from $1\frac{1}{4}$ in. $\times$ $\frac{1}{8}$ in. strip, carries two buffers made of mahogany, each of which is secured by a No 2 BA hexagon head screw pressed into a flat-bottomed hole and held by a nut and spring washer on the rear face. You may have to fit a register in the buffer to prevent it from rotating. You can use a No 6 wood-screw with the head removed and made to protrude about $\frac{1}{8}$ in. A suitable hole in the buffer beam would complete the register. The beam is then attached to the side plates by two pieces of $\frac{1}{2}$ in. $\times$ $\frac{1}{2}$ in. $\times$ $\frac{1}{8}$ in. angle, and No 4 BA, $\frac{3}{16}$ in. hexagon head screws.

Besides being easy to provide, the tubular stiffeners shown here are more rigid than those made from plate and angle. They stiffen the frame in two planes. As the $\frac{3}{4}$ in. dia. locating hole in the plates can be put in while the plates are clamped together for all the other holes, the alignment of the side plates is assured. You can hold the stiffeners on a

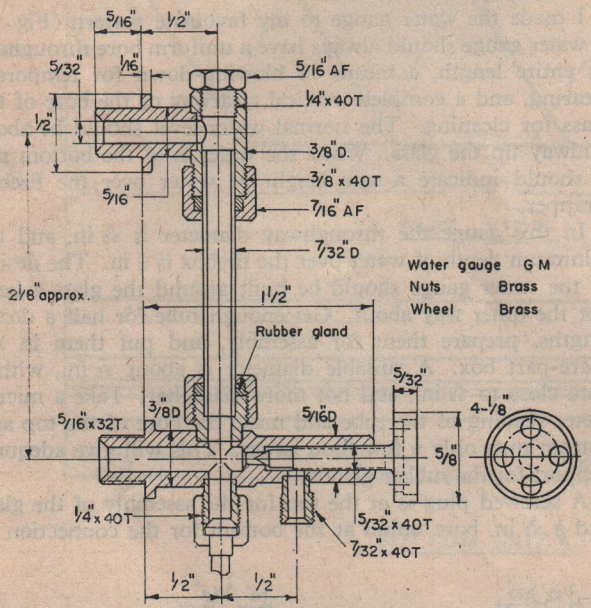
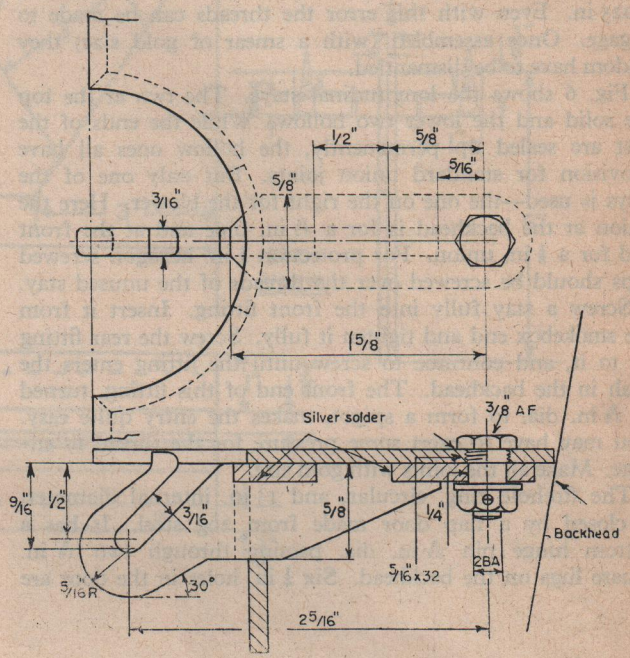


Fig. 7: Water gauge



Detail of drag hook

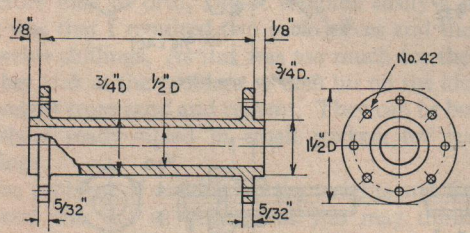
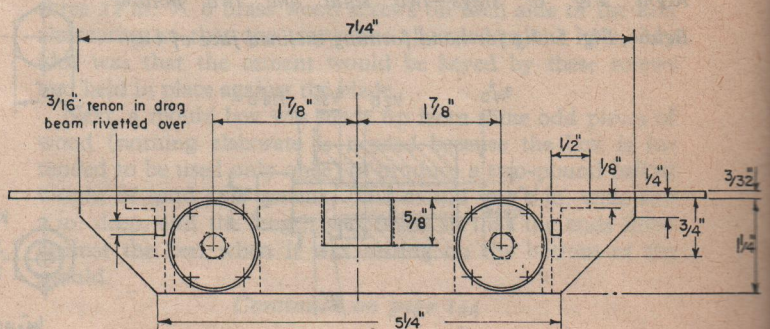


Fig. 8: Alternative pattern frame stiffener in GM



mandrel between centres and skim the outer faces as a last operation at one setting. This too helps with the alignment. The tubular stiffener in gunmetal seen in Fig. 8 is formed by plain turning.

We cut the footplate proper (Fig. 9) from $\frac{3}{32}$ in. mild steel plate so that it extends forwards along the sides of the firebox and clears it by $\frac{1}{32}$ in. each side. It is stiffened underneath by a frame made from $\frac{3}{4}$ in. × $\frac{1}{2}$ in. × $\frac{1}{8}$ in. angle as longitudinals, and a buffer beam of $1\frac{1}{4}$ in. × $\frac{1}{8}$ in. strip with a semicircular gap formed in the middle to accommodate the draghook. The angles are tenoned into the buffer beam and riveted over as shown. Pieces of $1\frac{1}{4}$ in. angle reinforce the joints between the buffer beam and the angles, with six $\frac{3}{32}$ in. rivets in the angle flanges, four in the buffer beam and two in the longitudinals. The $\frac{3}{32}$ in. plate is attached to the longitudinals by six $\frac{3}{32}$ in. rivets each side. It is these rivets which take the drawbar pull. They are the coupling between the draghook axis pin fixed in the $\frac{5}{16}$ in. × $\frac{3}{32}$ in. hole and the bushed ends at the front of the longitudinals, which are attached to the drag-rod by two special $\frac{7}{32}$ in. screwed pins with $\frac{5}{16}$ in. hexagonal heads. We attach the plate to the buffer beam by 8 BA screwed studs which can be cut off clean at the surface and are therefore invisible.

I have mentioned the coupling to the drag-rod. A second coupling, to control the footplate in a vertical direction, is by two 2 BA screws in lugs on the backhead. On assembly, the attachment to the drag-rod must be made first, before the two 2 BA screws passing through the clearance holes are tightened down.

The draghook is fabricated to form a T-section 3 in. × $\frac{5}{8}$ in. The vertical member, $\frac{3}{16}$ in. thick, embodies the hook; it is tenoned into a slot in the horizontal member and is silver soldered. Anchorage to the footplate is by a screwed pin which has a $\frac{3}{8}$ in. hexagon head and $\frac{1}{4}$ in. dia. stem and is made permanent in the footplate by silver soldering. The hook can then be pivoted at its inner end and controlled vertically in a slot in the buffer beam so that it can move each side of the centre line by about 13 deg. A nut and $\frac{1}{16}$ in. split pin on the 2 BA thread retain the hook on the axis pin.

Accommodation for the hand pump is on the right of the footplate.

To be continued

Model Engineer index

COPIES of the index for volume 129 of MODEL ENGINEER (May to December) may now be had from Percival Marshall and Co. Ltd, 19-20 Noel Street, London W1. Price is 1s., which includes postage.

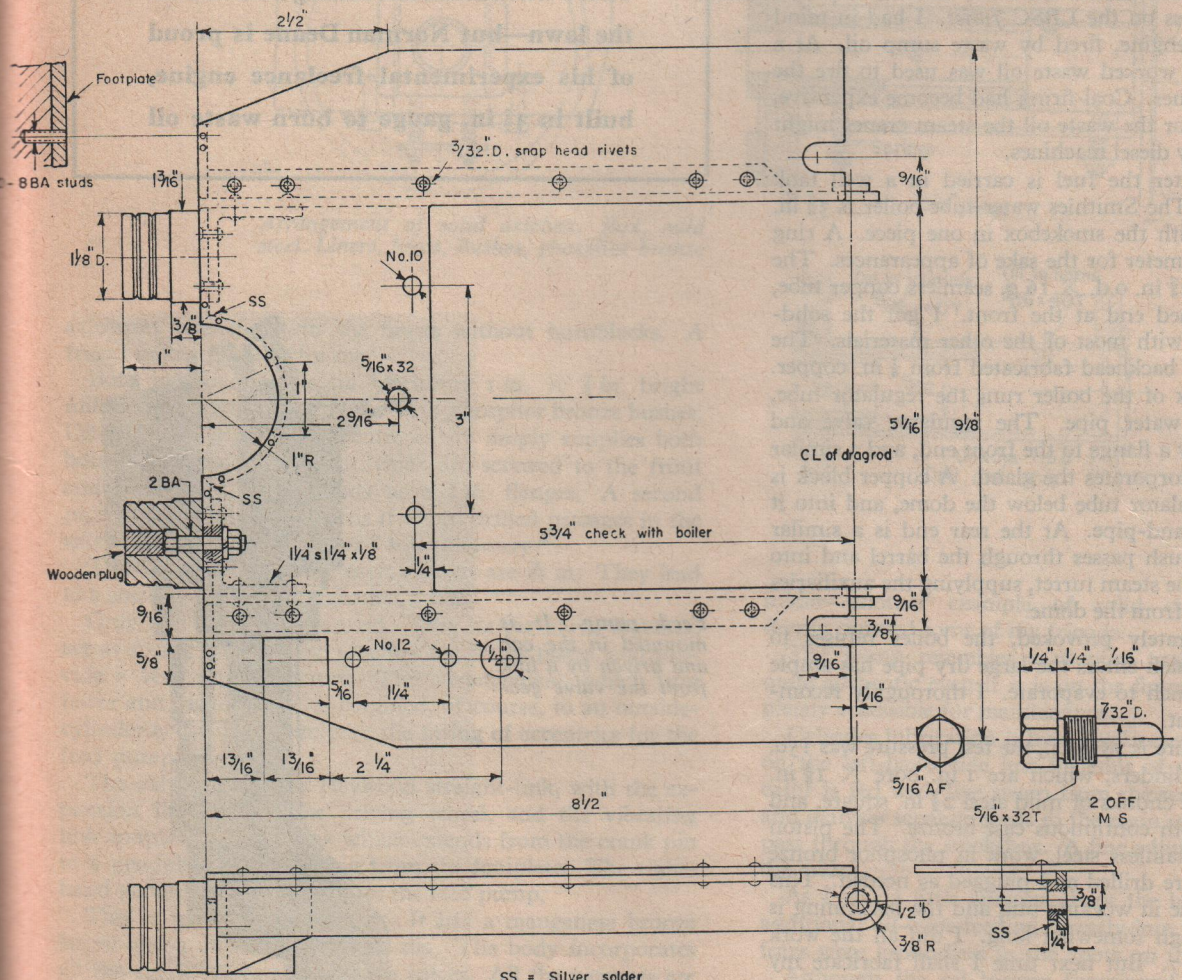
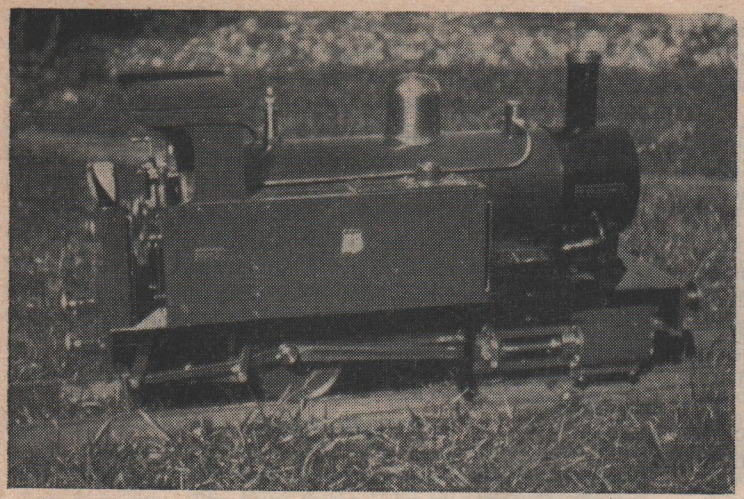


Fig. 9: Footplate



NO ONE WOULD TRY TO CATCH THIS RUNAWAY DOCK SHUNTER!

There was oil on the ceiling and fire on the lawn—but Norman Deane is proud of his experimental freelance engine, built in 3½ in. gauge to burn waste oil

IT IS sometimes said that free-lance models are made by those who cannot take the trouble to copy the original faithfully. But, some modellers like to incorporate ideas of their own, or to make certain parts more substantial than they would be at true scale.

My 3½ in. gauge dock shunter has a few unusual features. It is based more or less on the LBSC *Juliet*. I had in mind a superheated 0-4-0 engine, fired by waste sump oil. At a factory where I once worked waste oil was used to fire the boiler of the yard cranes. Coal-firing had become expensive, and had it not been for the waste oil the steam cranes might have been displaced by diesel machines.

On my dock shunter the fuel is carried in a well tank between the frames. The Smithies water-tube boiler is 3⅝ in. o.d. and 16 s.w.g., with the smokebox in one piece. A ring gives an increased diameter for the sake of appearances. The inner boiler barrel is 2¾ in. o.d. × 16 g. seamless copper tube, with an integral dished end at the front. I got the solid-drawn tube as scrap with most of the other materials. The firebox end has a wet backhead fabricated from ⅛ in. copper.

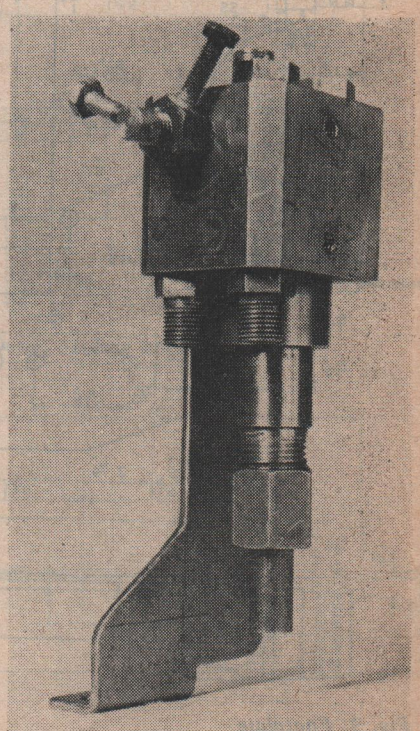
From front to back of the boiler runs the regulator tube, a ¾ in. bore copper water pipe. The regulator valve and header are attached by a flange to the front end, and a similar flange at the back incorporates the gland. A copper block is brazed on to the regulator tube below the dome, and into it screws a ⅜ in. o.d. stand-pipe. At the rear end is a similar block. A ⅜ in. bore bush passes through the barrel and into the block: it carries the steam turret, supplying the auxiliaries with dry steam direct from the dome.

Even when deliberately provoked, the boiler refuses to prime. Any water which enters the large dry pipe has ample time and space in which to evaporate. I thoroughly recommend this arrangement.

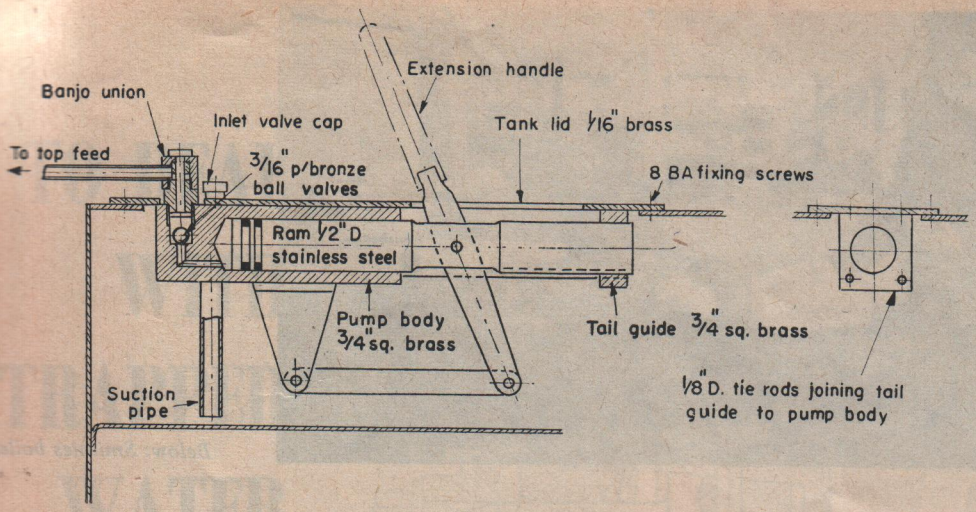
The working pressure is 75 p.s.i., the test pressure was 150.

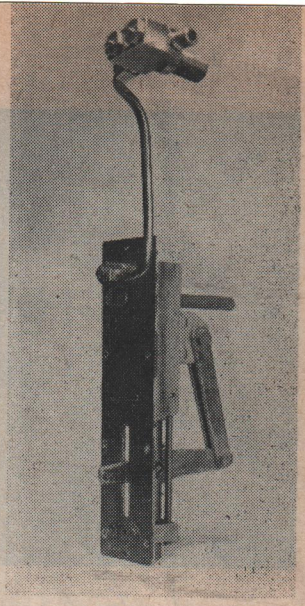
I machined the cylinders, which are 1 in. bore × 1⅜ in. stroke from two solid chunks of mild steel 2½ in. square, and lined one of them with continuous cast bronze. The piston valves, of ½ in. dia. stainless steel, work in phosphor bronze liners. All passages are drilled and plugged as needed. This method makes for ease in working out, and the machining is straightforward, though somewhat long. I did all the work on a Myford Super 7. But next time I shall fabricate my cylinders.

For the frames I used 3 in. × ¼ in. bright mild steel. The

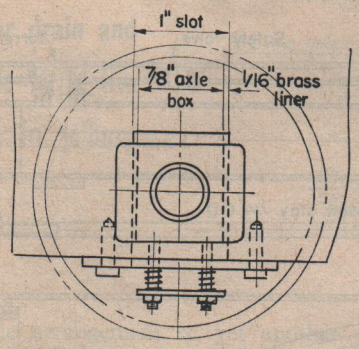


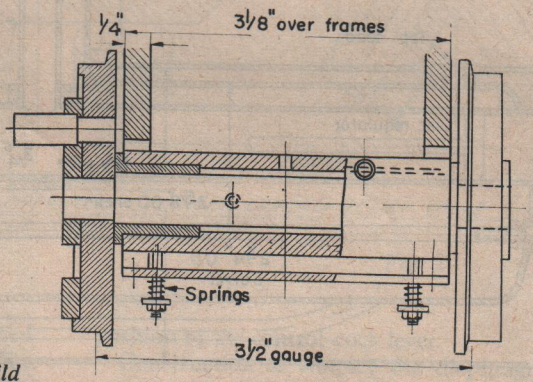
Feed pump. It is mounted in the cab and driven by a link from the valve gear

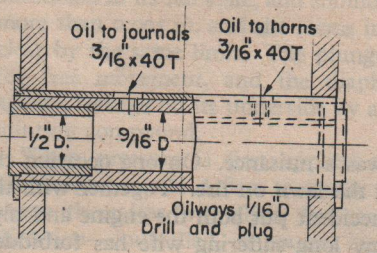

Extension handle
Banjo union
Inlet valve cap
Tank lid 1/16" brass
To top feed
3/16" p/bronze ball valves
8 BA fixing screws
Ram 1/2" D stainless steel
Pump body 3/4" sq. brass
Tail guide 3/4" sq. brass
Suction pipe
1/8" D. tie rods joining tail guide to pump body



Emergency hand pump







Arrangement of solid axlebox. Box, mild steel. Liners, brass. Bushes, phosphor bronze

axleboxes ride direct in the horns without hornblocks. A friend milled the slots for me.

Both axleboxes are solid blocks of 1 in. × $\frac{7}{8}$ in. bright mild steel, bored and furnished with phosphor bronze bushes. Oil fed by a pipe to the centre cavity amply supplies both bearings. Brass liners $\frac{1}{16}$ in. thick are screwed to the front and back faces. Their ends have $\frac{1}{8}$ in. flanges. A second pipe supplies oil to the horns through drilled passages in the axleboxes. I have a liking for " solid circuitry."

The two oil-pipes from each axlebox are $\frac{3}{32}$ in. They lead to a small oilbox on the right-hand side.

Only two hornclips are used. They tie the horns together, act as spring guides, keep together the frame plates, and provide a very rigid structure. This arrangement, which uses fewer and bigger parts, is confined, of course, to an outside-cylinder engine and precludes the fitting of eccentrics for the feed pump.

The valve gear is the Heywood straight-link, with the expansion link behind the driving wheel, and the vibrating link coupled to a jack link which extends from the crank pin to a pendulum link hanging from the footplate. The right-hand pendulum link also drives the feed pump.

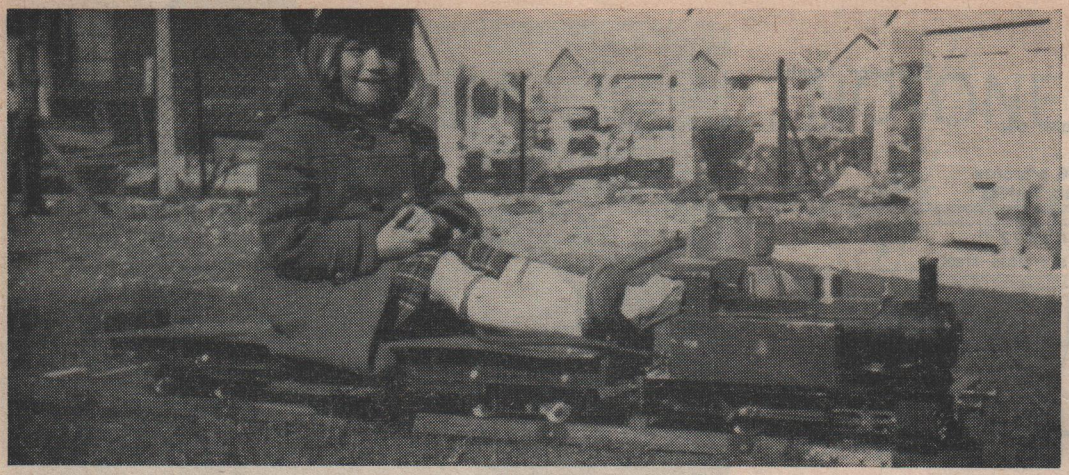
This is mounted in the cab. It has a manganese bronze barrel and a stainless ram $\frac{1}{4}$ in. dia. The body incorporates all the check valves and by-pass valves. All the passages are drilled and plugged. The plugs are invisibly sealed by silver solder—another example of solid circuiting which has deeply puzzled some of my friends.

The pump resembles a vacuum brake ejector and looks quite authentic even if it is on the fireman's side. It is completely accessible for maintenance.

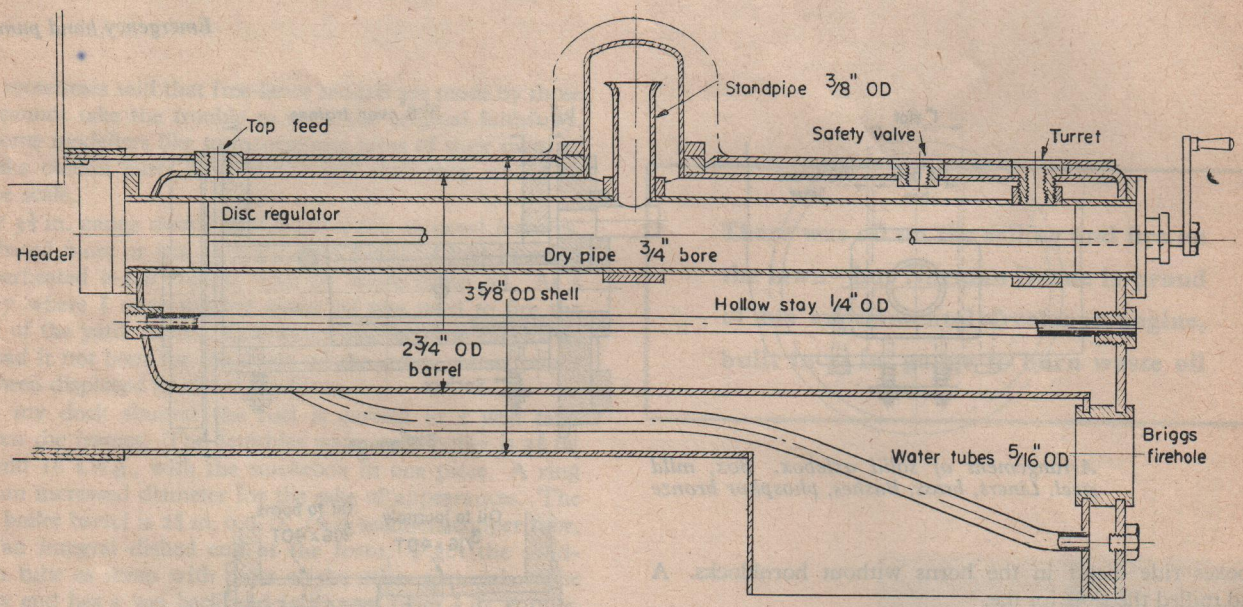
Cylinder lubrication is by a displacement lubricator carried on the left-hand side just in front of the tank. The lubricator is fed with live steam from the wet side of the header, and delivers separate feeds to the main steampipes where they pass through the smokebox. A fine adjustment valve controls the steam.

As I was a little anxious about the lubricator, I provided additional oil-cups feeding directly into the steam chest. My fears were groundless as the spots on the hall ceiling prove.

Although the oil burner functioned very well, the tank did not hold enough oil for my liking, and the need of



Below: Smithies boiler



frequent replenishing was a nuisance. On one occasion the burner flooded and set the lawn on fire. Together with the oil on the ceiling, the accident put both the engine and myself in disgrace, and my long-suffering wife has forbidden me to run it indoors.

I tried to use Calor gas as a fuel. All that I did to the burner was to remove the vaporising coil. The fuel tank and valve are still in circuit, and I can return to oil-firing if I wish. "Throw away" butane cartridges, as used on a 10 lb. cylinder, can be carried on the truck. They are unsightly but much cheaper !

The hand-feed pump is in the left-hand tank, mounted on the underside of the lid, through which appear the valve caps and delivery union. As the pump comes off together with the lid, there is no need for me to fiddle about inside a narrow tank when I am making an adjustment. Both pumps deliver to a working twin top-feed clackbox.

No injector is provided as yet, but a third check valve, a standard Tecalemit fitting below the footplate delivers through a Tecalemit banjo-fitting in the backhead. It is used for filling the boiler, the water being pumped in by a Ki-gass K2 engine primer, a very neat pump of $\frac{7}{8}$ in. bore $\times$ 5 in. stroke, which is carried in the toolbox. It can be used in the unlikely event of trouble with both pumps.

I did not employ any castings. The wheels were turned from solid blanks of 3 in. dia. free-cutting stainless steel, which is not quite stainless, and were quartered by the jig once described in ME.

I am very proud of the top-feed clackbox and of the brass dome casing, which I beat by hand from 16 s.w.g. brass in a surprisingly short time, after I had left this dreaded work to the very last.

On the first run the engine slipped a coupling pin and ran away. After scattering the spectators, who ignored my shouts of "Watch it !" and fled, it overturned on a curve. The only damage was to the concrete and the paint, a tribute to its hefty construction.

The sketches show the special features. As a radical departure from normal practice, the engine should interest readers who like to experiment and to simplify construction and maintenance.

In providing the boiler fittings, unions, valves and so forth, I made a complete spare set of everything. I was very glad I had done this, as one or two small parts went astray. They have since turned up deep down the back of the settee and in the vacuum cleaner. ▣

TO DEAL WITH TRAPPED WATER

Combined cylinder drain and relief valve made by a live steam enthusiast in Jo'burg

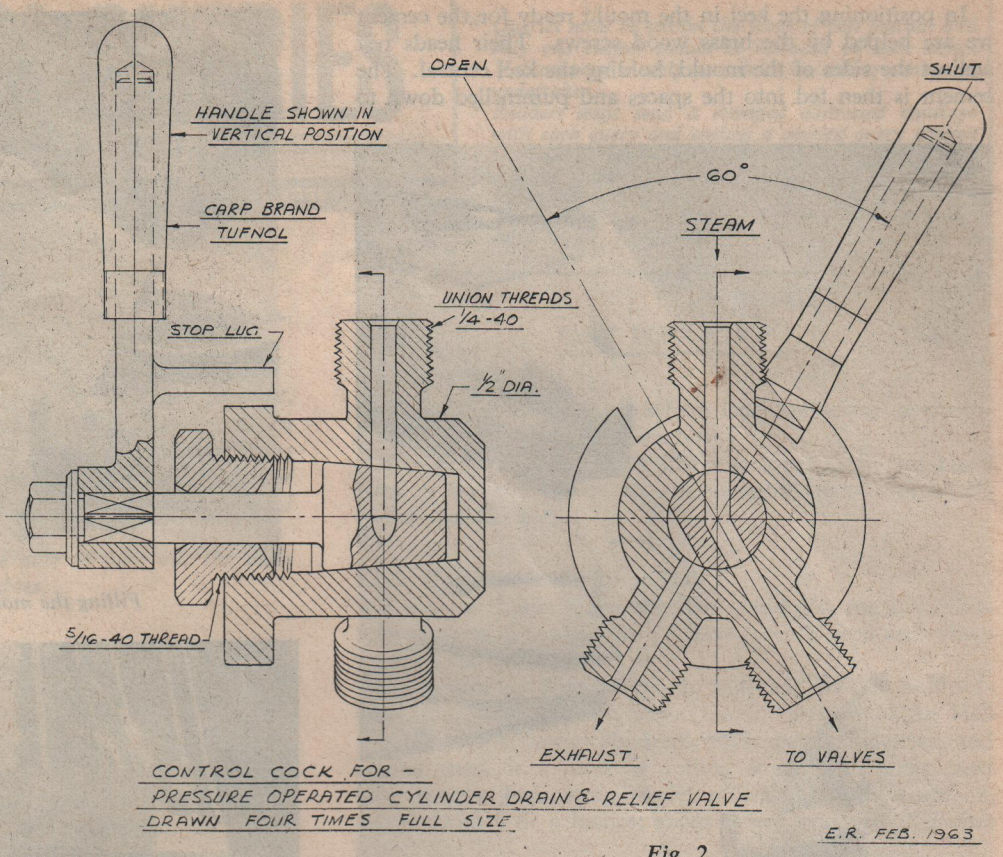


Fig. 2

FIG. 1 shows the arrangement of yet another combined cylinder drain and relief valve for model locomotives. The device is fitted to the ends of each cylinder and is worked by pressure. From a two-way control cock (Fig. 2) placed in the engine cab, a single $\frac{1}{8}$ in. o.d. pipe runs to a multi-way union fitting near the cylinders, with $\frac{3}{32}$ in. branch pipes to each valve.

When the pressure is on under the diaphragm, the ball valve is held firmly to its seat by the plunger. Even then, trapped water will bump the ball momentarily from its seat. With the pressure off, cylinder pressure takes over to open the valves. The action is instantaneous, according to the position of the control-cock lever.

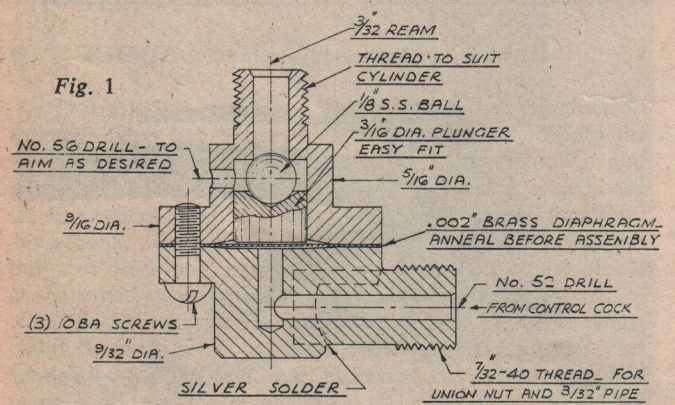

3/32" REAM
THREAD TO SUIT CYLINDER
1/8" S.S. BALL
3/16" DIA. PLUNGER EASY FIT
5/16" DIA.
NO. 56 DRILL - TO AIM AS DESIRED
9/16 DIA.
.002" BRASS DIAPHRAGM. ANNEAL BEFORE ASSEMBLY
No. 52 DRILL FROM CONTROL COCK
(3) 10BA SCREWS
9/32" DIA.
SILVER SOLDER
7/32-40 THREAD FOR UNION NUT AND 3/32" PIPE
CYLINDER DRAIN AND RELIEF VALVE
DRAWN 4 TIMES FULL SIZE
E.R. FEB. 1963

Fig. 1

Construction is simple; the diaphragm is annealed and assembled in its flat state, and should clear the plunger by not more than 0.005 in. and the recess in the bottom part should clear by the same limit. The plunger is an easy fit to allow for free movement, and the diaphragm should be sealed against leakage on its underside by a small amount of steam-jointing compound.

When pressure is first applied to the underside of the diaphragm, it will deflect to touch the plunger, and its new shape thereafter will allow for movement in the opposite direction—controlled, of course, by the depth of the recess. The recess also takes the bump when water is being dealt with, thus preventing damage to the diaphragm. I have found a total movement of 0.010 in. suitable for normal conditions.

Maintenance

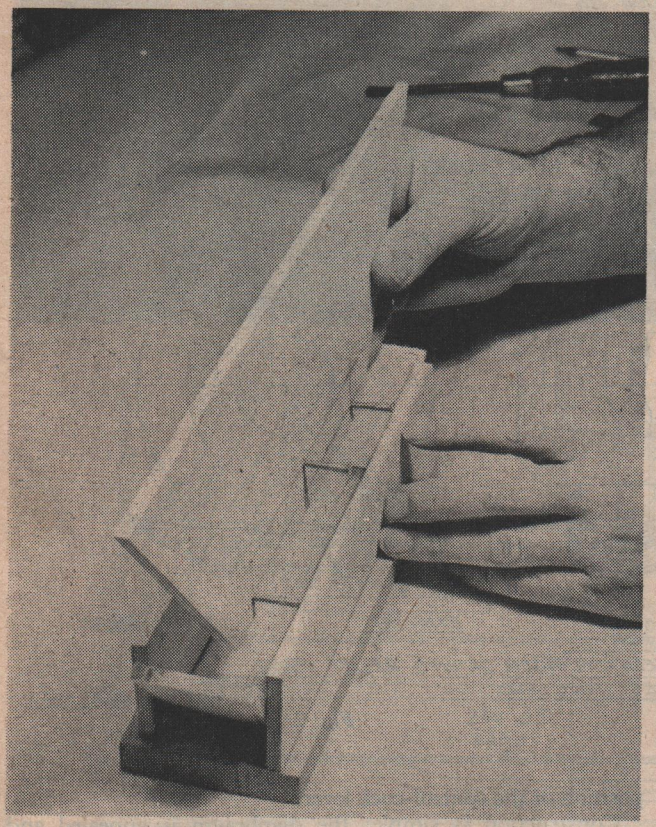
While the valve units require no maintenance, the control-cock plug should be treated with graphite lubricant now and again. The valves can be of brass, but the control-cock body needs to be a good bronze, and the plug of rustless steel.

The single steam pipe to the front of the engine takes the place of the usual lever and rod system used with mechanically-operated valves. It can be placed out of sight. There is no trouble with condensation.

As the valves act automatically in dealing with trapped water, they are eminently suitable for piston valve cylinders. The few dimensions shown in the sketches are for engines of 1 in. scale.

E. ROWBOTTOM.

In positioning the keel in the mould ready for the cement we are helped by the brass wood screws. Their heads rest against the sides of the mould, holding the keel central. The cement is then fed into the spaces and pummelled down to



Placing the keel into the mould box. Wood screws holding the work centrally

remove the possibility of air pockets. As the cement dries it tends to shrink slightly, making the withdrawal from the mould a simple task.

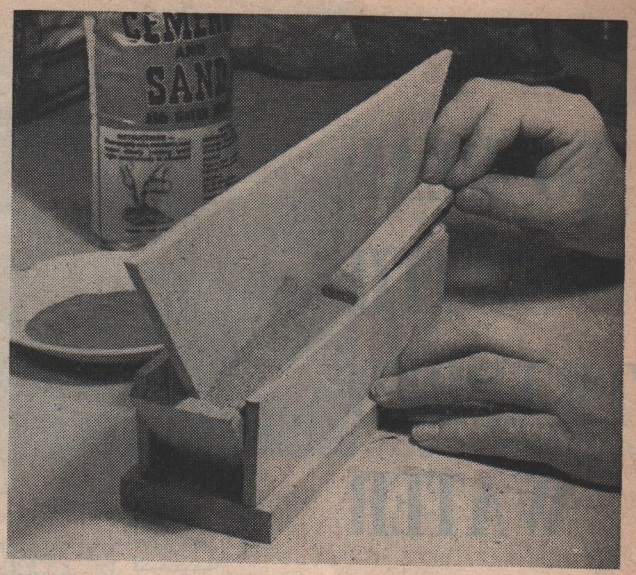
Examine the newly-made weight for any blemishes. You may find a small indentation showing that you were not successful in excluding all the air. If the work generally is sound, any slight defects can be remedied with a little filler before it is made ready for painting.

After the keel has been fitted satisfactorily take a file and remove the square corner from the forward end of the slide, so that it blends gracefully into the upward sweep of the bow.

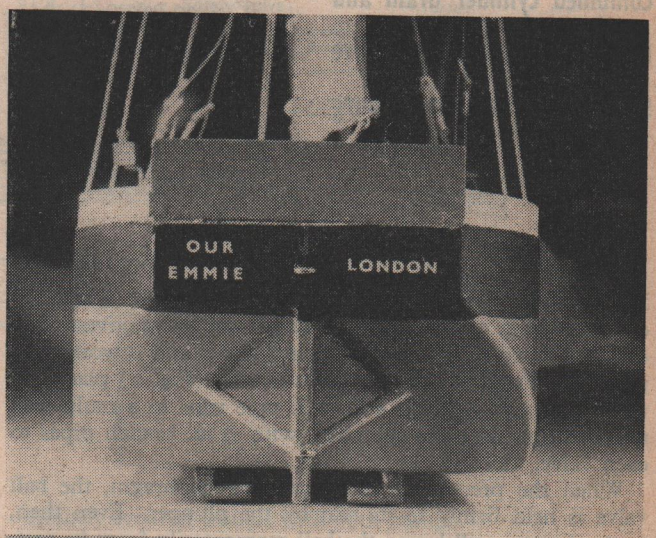
Before the hull is turned the right way up, there is one further important item to be added—the deadwood. This was fitted to the stern of the early sailing barges and has been handed down to the present-day lighters. It is positioned centrally; its purpose is to keep these shallow draught vessels straight and manageable.

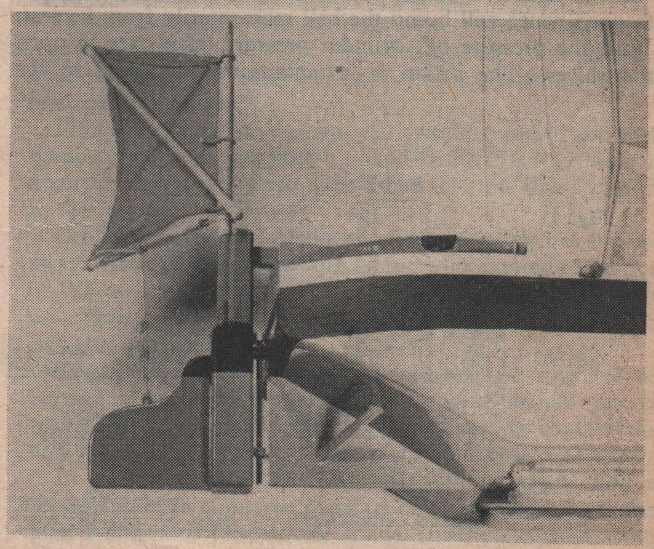
Fitting it to the model is an easy task. Take a piece of 3 in. × $\frac{3}{16}$ in. obeche, or a similar wood, not less than 4 in. in length. Draw a line from one corner to the opposite side of the wood, 4 in. back. Cut along this line with a tenon saw and fit the wood to the stern on the centre line which was marked in earlier. The bottom edge of the deadwood should be level with the bottom of the hull and its length is cut to bring it in line with the transom.

Continued on page 145



Filling the mould box with cement





Two views of the stern showing the deadwood and bracing stays

READERS' QUERIES

DO NOT FORGET THE QUERY COUPON ON THE LAST PAGE

* *Queries must be within the scope of this journal and only one subject should be included in each letter.*
* *Valuation of models or advice on selling cannot be undertaken.*
* *Readers must send a stamped addressed envelope with each query and enclose a current query coupon from the last page of the issue.*
* *Replies published are extracts from fuller answers sent through the post.*
* *Mark envelopes "Query," Model Engineer, 19-20 Noel Street, London W1.*

Valve liners

Are the end-plugs of the valve liners for *Caribou* a press-fit ?—R.J.C., Salisbury, Rhodesia.

▲ *The end-plugs do not need to be a proper press-fit, as they are subjected only to exhaust steam pressures. In fact they may be turned to a hand push-fit and driven home with a very light tap from a mallet. They can then be secured with three brass or gunmetal screws, put in around the periphery at 120 deg.*

You will find it helpful to be able to take out the end-plugs when you are fitting new valves.

Hot-air engine

How do the cranks work on a hot-air engine ?—R.L.C., Letchworth, Hertfordshire.

▲ *In single cylinder hot-air engines which work on the normal principle, the two cranks for the power and displacer pistons are timed at about 90 deg. from each other, so that the two pistons are out of phase by this amount. In multi-cylinder engines the cranks or the cylinder passages may be connected to conform with the phase difference.*

Titfield Thunderbolt

How thick should I make the rims of the wheels for a 5 in. *Titfield Thunderbolt*, and what is the shape of the spokes ?—A.C., Ferndown, Dorset.

▲ *No dimensions for the rims or spokes were given in the drawings of* TITFIELD THUNDERBOLT. *The rims would be about $\frac{7}{32}$ in. deep, not allowing for the flanges.*

In model wheels, the spokes are generally made a triangular section. They would be about $\frac{3}{8}$ in. deep near the rim, about $\frac{13}{32}$ in. deep near the boss, about $\frac{5}{32}$ in. thick at the back, tapering to $\frac{1}{16}$ in. at the front.

OUR EMMIE *continued from page 144*

When this has been done, the part can then be glued to the hull. You had better insert two panel pins to hold the work in position while the glue dries. To strengthen and support the deadwood, two bracing pieces are added, one on either side. They can be cut from $\frac{1}{16}$ in. diameter dowel $1\frac{1}{4}$ in. long, and are filed so that they sit flatly against the hull and deadwood, held by a spot of glue. They are placed at about half-way along the deadwood.

In the February 1 instalment I said that Humbrol paints could be used in protecting the inside of the hull of *Our Emmie*. I would add that Humbrol, who have supplied model engineers for many years, also market a good primer for ship modelling work, and a range of wood cements.

To be continued

CAN YOU HELP ?

American shrimp boat

Can any readers tell me where I can get plans or photographs of an American shrimp boat ?

The vessel is very much like a ring-net boat, but has a sizeable forward cabin on the steering house.—H.A.J.F., Mountmellick, Eire.

Little Horsebox at Blithfield Hall

I wonder if any of your readers could give me any information about a model which I have recently seen and which interests me greatly ?

Some time ago I paid a visit to Blithfield Hall, in Staffordshire, the home of Lady Bagot. In the nursery of the Hall there is a collection of children's toys, mostly Victorian, and among them is a piece of rolling stock from what must have been a fascinating model railway. It is a horsebox, gauge about 8 or 9 inches; about 2 feet long and 18 inches high.

It is obviously a toy rather than a scale model, and is built for hard wear. But it is a very accurate representation of the real thing, and very well proportioned.

The wheels and axles are turned and flanged. Scale-size spring buffers and hook-and-chain drawgear are fitted. The woodwork is of quite a high order, with the usual mouldings of the period at sides and ends. The accommodation for the horses has hinged doors, the lower half dropping to form a ramp, and the two upper doors opening sideways. When open, the doors disclose two stalls, divided longitudinally, one of them occupied by a very life-like wooden horse, covered in hide, with a genuine horsehair tail ! The horse is saddled and bridled with a very neat set of harness.

A well-furnished passenger compartment for the grooms has glazed windows; its doors open and are fitted with drop lights. The seats are upholstered in a very professional manner, and linoleum covers the floor. Above the seats are four framed photographs on either side. In the roof is a large metal lamp housing, from which the lamp seems to be missing.

The doors have louvred "hit and miss" ventilators above the lights, and there are even hinged inspection doors in the top of the bulkhead between the passengers and the horses. Outside, the roof is covered in canvas, painted black. The bodywork is the usual reddish-brown, neatly lettered in yellow, CMR.

Lady Bagot told me that the model had come from a London antique dealer. According to him it was part of a complete train which had been split up.

I should be interested to find out more about the train, and the railway on which it ran. Have any readers seen a similar piece of rolling stock anywhere else, or can they give me any more information ?—F.H.C., Lichfield, Staffordshire.

The Editor welcomes letters for these columns. A PM Book Voucher for 10s. 6d. will be given for each picture printed. Letters may be condensed or edited

POSTBAG

Preserved in reserve

SIR,—While on holiday I came across a traction engine in the Chaffey Reserve at Mildura in Victoria. The Reserve is a memorial to the Chaffey Brothers, pioneers in the district, who started what has since developed into an extensive irrigation system.

I saw there a 550 h.p. triple expansion engine designed by George Chaffey and built in 1889. It supplied water to the area until 1955. The average hourly output was 1,956,420 gallons.

The traction was one of a number of engines used for clearing land for irrigation. Their names were *General, Colonel, Lieutenant, Dragon, Dentist* and *Savage*. They supplied the power for ploughs, scarifiers and graders.

Across the road from the Reserve is the home of the Chaffey brothers, now a museum.

I find the enlarged magazine very interesting. Apart from a break during the war I have been a subscriber for nearly thirty years.

Baulkham Hills, N.S.W. C. PAYENS.

Trip to Yesterday

SIR,—I have just received the Christmas Number of the MODEL ENGINEER, and am very much interested in the pictures of the Diamond Jubilee celebrations of the Selukwe branch of the Rhodesia Railways. Had I not been away on holiday, I should have been present. Selukwe is only 55 miles from here.

From Gwelo to Selukwe and back is not more than 50 miles. The 400 miles was the total distance from Salisbury to Selukwe and back.

The picture of passengers in open trucks was taken on the 2 ft gauge line of the Rhodesia Chrome Company at Selukwe, and the coaches hauled by No 43 were period vehicles of Rhodesia Railways stock. The end of the first coach visible in the top picture shows that it was built before 1914. Four years ago I travelled in one like it, dated 1904, from Salisbury to Gwelo. It was reasonably comfortable, but rather cramped, especially as I was travelling second class—six passengers to a sleeping compartment.

I have not seen a 7th class locomotive for some time. Ten years ago they were fairly numerous, and used mostly for shunting. They were built about 1899 or 1900, by Neilson's.

Their successors, the 9th class of 1912, have almost disappeared. I believe that one or two are still shunting in Bulawayo yards. Up to a few months ago, in rebuilt form as 9Bs, they used to work into Shabanie with the thrice-weekly train. Their place has been taken by the 12th class 4-8-2s, heading the mail trains to the north. All main-line work is now done by Garratts, and on the Que Que-Salisbury-Umtali line by diesels.

Congratulations on a very interesting Christmas Number, and all the best for the New Year.

Shabanie Mine, Southern Rhodesia. R. W. REYNOLDS.

Africa to Canada

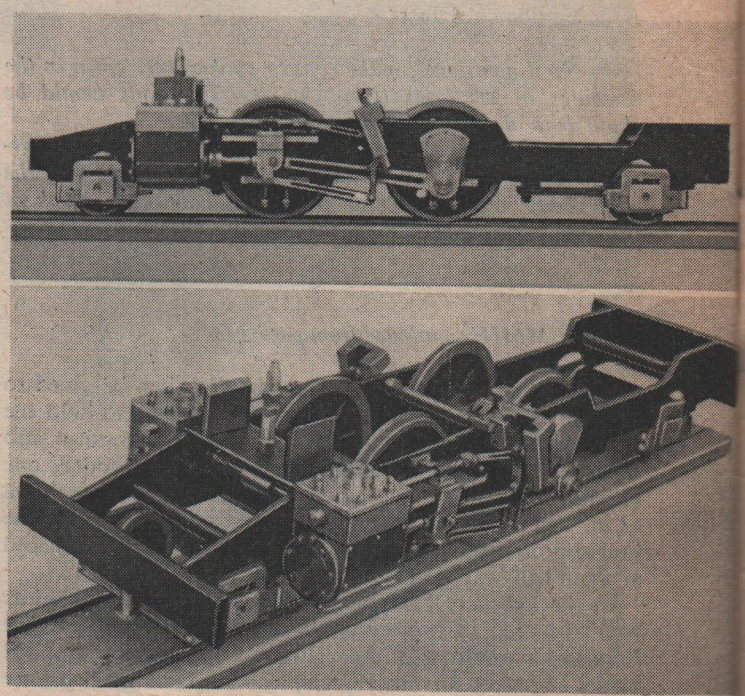
SIR,—Readers may be interested in the photograph of my chassis for the South African narrow-gauge engine designed by K. N. Harris. I scaled it down to 3½ in. gauge.

It has the Joy valve gear of Mr Harris's dimensions. No matter in what position the cranks stop, the motion starts without effort. At 60 lb. from the test boiler there is no holding it.

I had only the side and front elevation in ME of 27 September 1962. So far I am extremely pleased with the result.

On the main axle will be twin pumps of $\frac{5}{16}$ in. bore and ½ in. stroke. At present I am working on the copper boiler.

Essex, Ontario. FRANK BIRCH.



In Ontario Frank Birch is making the model South African narrow-gauge locomotive described in ME

End of the day for old CLAUDE

Old Claude

SIR,—At Ravensworth Ann Colliery, beside the busy Great North Road (A1), I recently witnessed the end of *Claude*, a humble old 0-4-0 locomotive.

The engine was built in 1896 by R. & W. Hawthorn Leslie as No 2349 and was supplied to the Stella Coal Company. It later passed to Priestman Collieries and eventually to the National Coal Board. At the age of 57 it was registered by the Railway Executive.

It had brakes only on the driving wheels, and had been fitted at some time with an ICI water softener. Two other 0-4-0 locomotives were standing in the yard. I am afraid that they, too, will have been cut up.

Newcastle-on-Tyne. E. H. JEYNES.

Steam cars

SIR,—I think it very unlikely that the Sentinel Wagon Works ever made a Doble steam car (Postbag, December 15). The likelier explanation is that when the American Doble ceased production in the early thirties, spares were passed to the Shrewsbury works for servicing and were eventually built into one complete vehicle.

The steam car had a much longer period of popularity in the USA than in Britain. The Doble, the last to cease production, was considered the Rolls-Royce of steam cars by the American public. At Springfield in Massachusetts the Rolls company had a factory which turned out cars like the Dobles. Kipling had two Locomobile steam cars when he lived at the Elms, Rottingdean. Dr Winter, who built the magnificent model *Como*, now housed in Brighton Library, ran a green Stanley steam car.

The steam car was not allowed to take part in trials and rallies. This was understandable; a steam car could pass any petrol car of the same age and power.

Readers often ask for information which would help them in building a steam car. To judge from the fine models made, they could build one without any trouble. I would suggest that a scaled-down version of the Clarkson bus would be successful. This excellent vehicle ran for ten or twelve years on London streets, with its silver-plated handrails, electric lighting from a separate generator, and red leather seats. The steam-wagon in Mr MacGillivray's photograph is a Thorneycroft with a top-feed coke boiler, and a two-cylinder undertype engine. Beards, the Lewes brewers, ran one like it about 1908.

Although I have spent over fifty years with petrol vehicles, part of this time in Coventry factories, I have always had a soft spot for steam. My fondness for it increased after I had been at Brighton Locomotive Works and at marine engine shops on the East Coast. Perhaps my father, who served with the Colchester firm of Davey Paxman Ltd, passed it on to me.

Brighton. G. GOLDRING.

How a magazine illustration can be used to decorate a copper bowl

Decorated bowls

SIR,—After reading Geometer's interesting article on the decoration of brass and copper bowls, perhaps readers would be interested in the way I decorated a few of them myself.

They were 12 in. in diameter and were spun on a lathe in the usual way. For the design I searched through magazines which contained suitable drawings similar to those which Geometer used to illustrate his punch decorations. I stuck them on the bowls, placed them on a flat piece of wood, and punched the design with a small straight chisel, after having first blunted the end. The bowl was then turned over and the clouds and sails were bellied out from the back with a ball pein hammer.

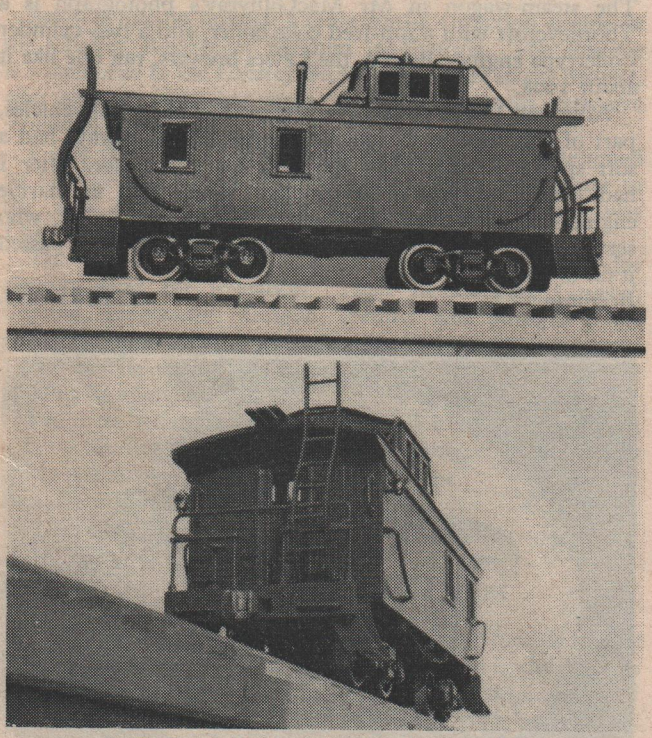
St Albans, Hertfordshire. R. WHEELER.

Caboose in New York

SIR,—My Kansas City Southern caboose was built at ½ in. scale to the elevation drawings by Ed Gebhardt in *Model Railroader* for January 1957. According to the title, the drawings were based on official railroad blueprints and intended for ¼ in. to the foot.

The original was described as having been built in the early 1900s. Attention was called to its distinctive appearance created by the short roof overhang at the ends, the old-style contour of the cupola, and the manner in which the ladders were curved to compensate for the overhang.

In 1959 Little Engines of Lomita, California, published pictures of the caboose in its catalogue and offered aluminium castings for its construction in 1 in. scale.



"Everything's up-to-date in Kansas City"

My caboose is of metal—chiefly sheet steel—with the sides deeply scribed to resemble boards. The hand rails are coat-hanger steel wire and the door and window sills are angle brass, riveted on with straight brass dress pins and sweated with soft solder. For the panelling in the doors I cut out sections and placed sheet metal on the inside. The door knobs are spherical-headed dress pins.

The steps are bent up from sheet metal and sweated together. The Bettendorf trucks are fully sprung. Little Engines supplied the castings for ½ in. scale freight car trucks and bronze castings for the automatic couplers. Making the lanterns was an interesting project in brass turning and silver and soft soldering. The lenses were machined from coloured plexiglass and fixed with model cement. Dummy turnbuckles are provided on the undercarriage trusses at either side.

I made the brake hand wheels by filing up the shape of the hub and curved spokes and soldering on the rim.

The caboose is painted a dusky red with black trim. Lettering has not yet been added.

New York. WARREN W. LACEY.

Maitre Horologer

SIR,—The old clock movement shown in Mr Carroll's photograph published in ME of October 1 is controlled by what is technically known as a pin-wheel escapement of the type invented by Amant about 1740. J. A. Lepaute in 1753 described an improved version of this escapement with pins on both sides of the escape wheel; it has been employed quite widely on the Continent, for both domestic and tower clocks.

Keeper, Department of Physics, Science Museum, London. F. A. B. WARD.

Maitre Horologer—2

SIR,—I think that the escapement of Mr Carroll's clock is the pin wheel escapement, which he will find described in detail in Britten's *Watch and Clockmaker's Handbook* (pages 381-384, 15th edition). According to this, the escapement was invented in 1749 by Amant, improved by Lepaute about 1753, and apparently used mainly in turret clocks.

May I use this letter as a plea for more articles on horology and the construction of clock mechanisms ?

Westbury-on-Trym, Bristol. L. SOWERBY.

Maitre Horologer—3

SIR,—The letter from Mr Carroll and the photograph of the old clock movement suggests that it is a variant of the Lepaute escapement invented about 1753. It was used principally in turret clocks and is similar in its action to the Graham.

Lepaute made his pins semi-circular, placed alternately on each side of the wheel to keep the pallets the same length. This arrangement was later altered to pins all on one side with pallets of unequal length. Grimthorpe afterwards changed the pin profile by cutting off the bottom face, making the section a trapezium with rounded ends.

Full details can be found in Britten's *Watch and Clockmaker's Handbook.*

Whitley Bay, Northumberland. F. L. DAVIES.

Maitre Horologer—4

SIR,—I have come upon a little further information about the pin-wheel escapement.

Britten's *Watch and Clockmaker's Handbook*—15th Ed., revised by J. W. Player (E. and F. N. Spon, 1955) says that the escapement was "invented by Amant (maître horologer) in 1749 and improved by J. A. Lepaute* about 1753 . . . Lepaute made the pins semi-circular and placed them alternately on each side of the wheel so as to get the pallets the same length. This requires double the number of pins, and there is no real disadvantage in having one pallet a little longer than the other, provided the short one is outside."

The handbook mainly treats the device as an escapement for turret clocks, and has little to say about its application to small domestic clocks. Gazeley, whom I mentioned in my previous letter, remarks that when the pins are very small the best results are obtained by having them circular and all the impulse on the pallets.

Acocks Green, Birmingham 27. NORMAN GARDNER.

** Jean Andre Lepaute (1709-1789) was an eminent Paris clockmaker and "Horologer du Roi" by appointment; Achille Brocot of Paris lived from 1817 to 1878.*

CLUB NEWS

Send news and notices to The CLUBMAN, 19-20 Noel Street, London W1

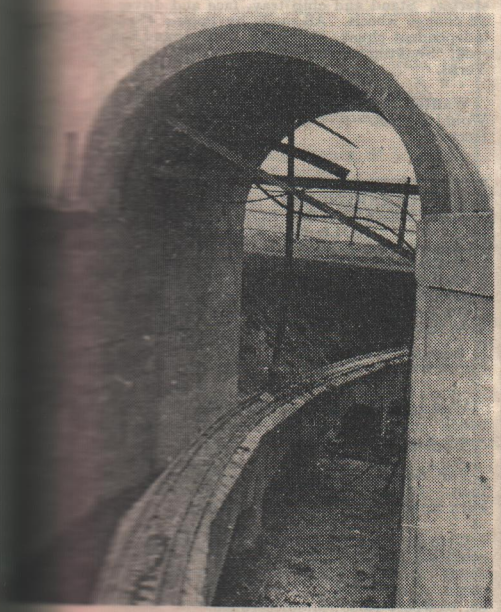
Busy Rochdale

Rochdale SME has a live-steam track 720 ft long, and members of the Society have been very busy in recent months making improvements to it.

The cutting at the pavilion end has been walled in with concrete. Arches are being erected to form a tunnel. Electricity laid on at the hut makes it possible for a "night shift" to work in reasonable comfort.

A colour-light signalling system is being installed and the Rochdale men reckon that when it is completed it will be one of the best signalling systems to be found on a model locomotive track. In fact, Thomas Brooks, the Society's publicity secretary, tells me that when the work is finished the improvements will make the track one of the best in the North of England.

It is no surprise, after hearing of these refinements, to learn that the main interest of the club is still in the locomotive section. Thousands of children, says Mr Brooks, were given rides in 1963. When they hear about the tunnel and the new signals the youngsters of Rochdale will be queueing up again.



Scottish cruise

Two centenaries, the launching of the passenger steamer *Iona III* and the founding of the North British Steam Packet Company (in association with the North British Railway) will be celebrated when members of the Scottish Locomotive Preservation Fund leave Craigendoran in the *Jeanie Deans* for a cruise in the Firth of Clyde on Saturday, May 9. The round trip, starting from Craigendoran and picking up at Gourock, will last all day.

At present the funds of the society stand at about £1,200. It hopes to announce before long the choice of locomotive to be preserved. The proceeds of the cruise will, of course, help the society in its aim, and the support of readers will be gratefully appreciated.

Mr John Warren, Outing Organiser, will be pleased to send full details and a booking form. His address is 19 Cleveden Gardens, Glasgow W2.

Steam at sea

An Australian reader, Mr Warwick Turner, writes to tell me of a society which he has formed for the preservation of marine relics from the steam era, now rapidly drawing to a close in Australia. It is called the Lady Hopetoun and Port Jackson Marine Steam Museum Society.

Plans have been drawn up for a museum to be built on the north shore of Sydney Harbour, under the shadow of the famous bridge.

The main object is to preserve in running order the 61-year-old steam yacht *Lady Hopetoun;* she is to be retired at the end of this year. Another vessel which the society hopes to preserve is the steam tug *Port Jackson* which has plied in Sydney Harbour since 1911. Small examples of marine steam machinery will have a place as well.

CLUB DIARY

Dates must be sent at least four weeks before the event

February 17 Wigan MES. Meeting. Co-operative Guild Room, Thompson Street, Whelley, Wigan, 7.30 p.m.

February 19 Birmingham SME. Technical film show. Endwood Hotel, Hamstead Road, Handsworth, 7.30 p.m.

February 21 Coventry MES. 8mm. film show by Messrs Selby, Drury, Bedder, Priory School, Wheatley Street.

February 22 The Historical Model Railway Society. Talk by Mr J. I. Vaughan, "Seen on Safari," College for Adult Education, Lower Mosley Street, Manchester 2, 2.30 p.m.

February 22 York SME. Talk "Dental Technology" by Mr Dobson, British Legion premises, Micklegate, York.

February 22 Sussex Miniature LS. Annual meeting at the Club House, Beech Hurst Track, Hayward's Heath.

February 22 SMEE. Visit to the workshops of John B. Thorpe, 98 Grays Inn Road, WC1.

February 26 Southampton and District SME Dr Urmston's films on track construction.

February 26 Harrow and Wembley SME. Marine section meeting, Heathfield School, 8 p.m.

February 27 Hitchin and District MEC. Annual General Meeting. Club House, Grove Road, Hitchin. 8 p.m.

February 28 Brighton and Hove SMLE. Bits and pieces night. St Luke's School, Finsbury Road, Brighton, 8 p.m.

February 29 SMEE. Rummage sale. 28 Wanless Road, London SE24, 2.30 p.m.

March 3 Harrow and Wembley SME. Committee meeting.

March 4 Guildford MES. Annual meeting.

March 4 Birmingham SME. Annual General Meeting, Endwood Hotel, Hamstead Road, Handsworth, 7.30 p.m.

March 6 Coventry MES. Talk by Mr Medlicott on traction engines, Art Room, Priory School, Wheatley Street.

March 6 Colchester SMEE. Illustrated talk "More About Traction Engines" by Mr A. Clark of Rayne. East Bay House.

March 7 Historical Model Railway Society London area annual general meeting, Keen House, Calshot Street, N1, 6.30 p.m.

March 7 Historical Model Railway Society. Meeting. Restaurant Car of the Dowty RPS, Northway Lane, Ashchurch.

Norwich plans show

Until the war the Norwich and District SME, which was founded in 1933, held an annual exhibition. Since the war only two shows have been held, one in 1950 and the other six years later. Now Norwich is planning an exhibition to be held in the autumn, and provisional arrangements have already been made for the use of the main hall of the Territorial Army Centre in Aylsham Road.

The show will be open from noon on Wednesday October 28 until Saturday, with admission until 9.30 each evening. After the first day the opening time will be 10 a.m.

Norwich hope to attract a large number of entries in the loan and competition classes. Silver and bronze medals will be awarded, and there will be diplomas for varying degrees of commendation.

Classified Advertisements

Private: 3d. per word. Trade: 8d. per word. Minimum 12 words. Use of Box No. 2s. 0d. extra. Displayed Classified Advertisements: 35s. per single column inch. (Column width 2 3/16 in.). Series discounts: 24 insertions, 10%; 12, 5%. Full particulars on application. Receipts are only issued for orders of 20s. or over.

Advertisements, with remittance, should be sent to Classified Department, Model Engineer, 19-20, Noel St., London W1, by latest Feb. 17, midday. Advertisements will be accepted from recognised sources by telephone. GERRARD 8811, Ex. 31.

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Bucks & Ryan for Lathes and Workshop Accessories, drilling machines, grinders, electric tools, surface plates, etc.—101, Tottenham Court Road, London, W.1.

Largest Stocks of Bargain New Cutting Tools. Send for free list.—G. P. ENGINEERING TOOLS LTD., 813, New North Road, London, N.1. Phone: Canonbury 9977. Cables: Gepetra Londonni.

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Myford Lathes. Early deliveries of ML7 and Super 7. Terms arranged.—VICTA ENGINEERING CO., Blandford Road, Hamworthy, Poole, Dorset.

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SHEFFIELD 8 *Est.* 1889

75 × 100 mm. Swiss External Micrometer. New condition, £3 15s.—SHARP, 294, Coniscliffe Road, Darlington.

Wanted. Unimat or other small lathe.—PARKER, 33, George Street, Saltaire, Shipley, Yorkshire.

MILLING ATTACHMENT

M.E. 15 Dec., 15 Jan., 1 Feb.

Patterns for castings as described in articles are being prepared. Enquirers will be advised when ready. S.A.E. please.

Castings and Drawings:

ATOMAG miniature magneto Mk. IX. Wgt. 12 oz.
ATOM-MINOR Mk.III, 2 stroke, 6 cc., air cooled.
KIWI, Mk II, 15 cc. 4-stroke, o.h.v., air/water cooled.
WALLABY, 30 cc. 4-stroke, Twin, water cooled. See picture page 74, 1st Feb. issue M.E.
WYVERN, horizontal, Gas or Petrol engine 50cc.
WHIPPET, 10 cc., water cooled, side valve.
CYGNET ROYAL, radial 3-cyl steam engine, ⅝ bore ½" stroke.
TRIDENT Mk. II, Horizontal boiler.
Workshop equipment. Save £'s compared with Commercial Prices

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B.O.C. Oxy-acetylene Welding Equipment, complete, perfect, seen working, £15 10s. Wolf ½" heavy-duty drill, £12 10s. Also Desoutter two-speed ½" drill, with bench drilling stand, superb unit, £25 10s. Both 200-250 v.—21, Hill Street, Summerseat, Bury, Lancs.

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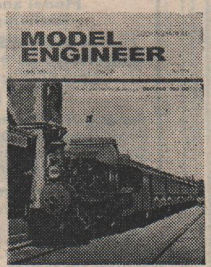

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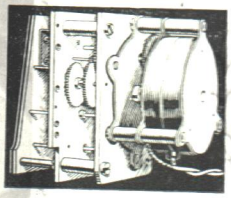

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